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PRACTICE EFFECTS IN FREE ASSOCIATION

By FREDERIC LYMAN WELLS, PH. D., Psychiatric Institute, Ward's Island, N. Y., formerly Assistant in Pathological Psychology in the McLean Hospital, Waverley, Mass.

From the Psychological Laboratory of the McLean Hospital.

While it is difficult to believe that any extended series of association experiments could be made without the appearance of some trace of practice effect, there has yet been no occasion, within the writer's knowledge, for the presentation of any systematized study of these effects. To make such a study with any degree of satisfaction requires a much larger series of stimulus words than is usually requisite for the immediate purpose of association experiments. For the present study, a list was constructed to consist of one thousand different stimulus words, which should be so far as possible unambiguous, and familiar to the class of subjects dealt with. These words were written on as many separate slips of paper, which were then placed in a large box and thoroughly shaken together for 15 minutes. The slips were then drawn from the box at random, one at a time, and made up into twenty series of 50 words each. A revised list will be an improvement over this one, which has, however, shown entirely sufficient adaptability to the present experiments.

One series of 50 words was given to each of six subjects each day, six days in the week, until the entire twenty series had been given. On the next two days the first two series of 50 words were repeated. The present results are based essentially upon these experiments, totalling 6,600 observations; especially on the two series that are repeated. Two other subjects reacted to 500 words each. About a third as many

more observations were made with each of the first six subjects, with reference to special points in the experiment, but these results have only a limited application for the present purpose since the experimental material was here varied somewhat for the different subjects.

While regretting that there is no more accurate method of timing than the stopwatch, which permits other essential conditions of the experiment to be satisfactorily preserved, it must be acknowledged the most useful method available for timing the individual responses of the experiment. It was employed in all the observations here recorded. I have elsewhere spoken very distrustfully of this method, and it cannot be used for the interpretation of single measures on a minute scale. This is owing partly to the inherent coarseness of the measure, partly also to the inaccuracies of operation. In the present discussion the changes are sufficiently great as to be reliably reflected in this method of timing, which modifies the external conditions for the subject less than any other.

Of the six subjects with whom we are principally concerned, one is a highly educated physician in middle life, the remainder are women nurses, with one exception under 30 years of age. In Jung's classification of association types, four of the subjects belong to the Sachlicher Typus tending in different degrees towards the more subjective types; one is a fairly distinct Prädikattypus, and one rather a Konstellationstypus. The two other subjects, VII and VIII, are also women nurses under thirty, one being a Sachlicher Typus, the other a less marked Konstellationstypus.

The progressive changes in the time of the response, and the qualitative changes shown by the responses in the repeated series, form the basis of the present discussion. The most noticeable practice effect is that in reaction-time; the changes in the content of the responses are perhaps of an equally interesting nature, but hardly so well defined.

The accompanying cut illustrates the practice curve of the association time for each subject during the twenty consecutive daily series. The time unit, here as elsewhere, is 1/5 of one second.

The range of individual differences at the beginning of practice is here about 2:1, a range that is seen in many mental measurements, but in other observations with a larger number of subjects, this range is seen to be much nearer 3:1. The fastest subject here is about as fast as the writer has ever observed, but in other subjects from this group the median of 100 association times may run as high as 20 fifths, as in several of the series with subject VIII. The reaction times in the present experiments also run somewhat longer than those

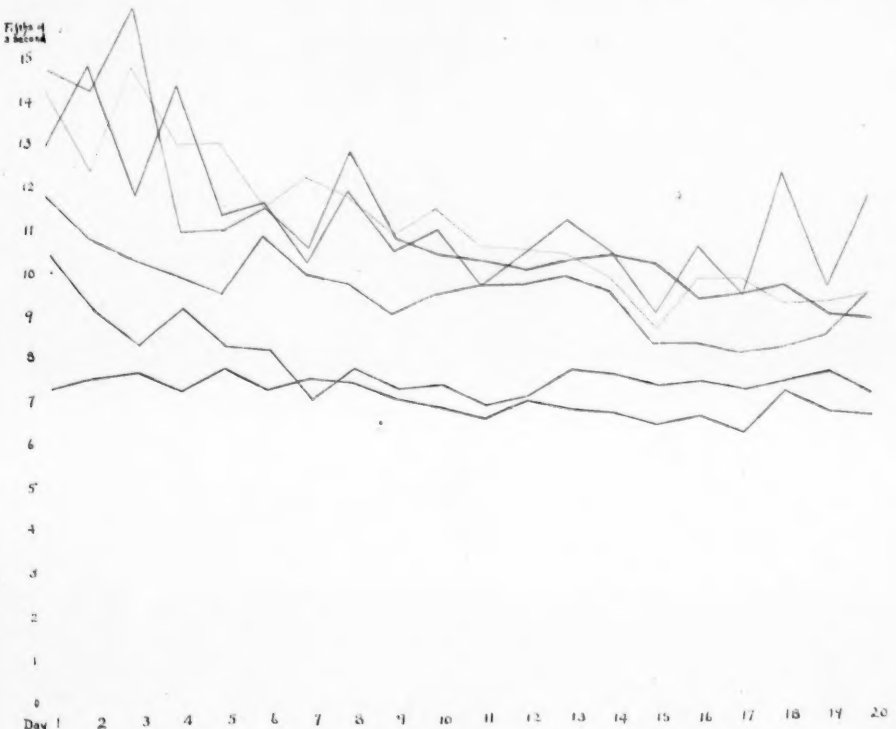
Fifths of a second
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Day 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

PLATE I.

reported by Jung, which, however, is amply accounted for by the greater difficulty of the individual series of words. A random selection of fifty from a thousand available words is naturally more difficult than a list of one hundred or two hundred words selected immediately.

The effect of practice seems to be towards a diminution of the individual differences in association time, although such a diminution is far from being what is found in all mental functions. Between three of the subjects (RED, ORANGE and GREEN) there is practically no such individual difference at any stage of practice, but in general the effect of practice seems to be to bring all the subjects near together at a certain psychological limit of quickness, which limit shows comparatively little individual variation. There are, therefore, very great individual differences in the closeness with which the different subjects approximate to this limit at the beginning of their practice. Thus subject BLUE starts well below any level which most of the subjects ever attain, and remains at this level throughout, the practice effect being almost absent so far as the association time is concerned. Other individuals have been observed, who, during the first observations with this test approximated to the short times here given by BLUE, and might be expected in further experiments to show as little practice effect. It seems fair to infer that the limit of quickness which any subject can attain by practice in this experiment, is equalled, if not surpassed, by other subjects at the beginning of practice, and these subjects then show little change during special practice. Some are born with the capacity for the promptest reaction, others achieve it only with special practice, and in very different degrees; still others perhaps not at all. And the general mental characters which give to one individual an inherently short association time are probably of a much more fundamental nature, and more important factors in the individual's make-up than those special characters which, developing during special practice, may give to another subject a somewhat greater facility in reacting.

Of the two subjects reacting to 500 words only, Subject VII shows nothing out of the ordinary, but the case of Subject VIII who shows an actual reverse of practice effect, is naturally of special interest. She seems to have a fairly good idea of the cause of the difficulty, which she describes as essentially a difficulty of choice between the large numbers of responses that would present themselves. Of this she is able to give quite detailed introspection in individual cases. She spoke of a difficulty in sufficiently focussing the "attention" *verbo ipso*. She said that the novel experimental conditions had

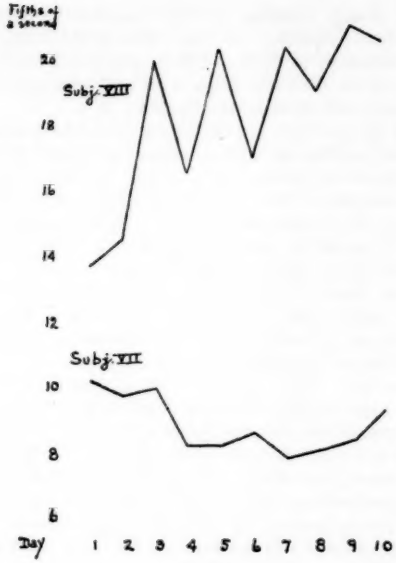

PLATE II.

"rattled" her a little only on the first two days, when as a matter of fact she was quickest. She denied absolutely that any conscious suppression of disagreeable associations had influenced the results and was able to definitely assign such a process in but one specific instance. It may be added that the subject is of an entirely normal make-up, and in education, mental balance, and professional efficiency, will bear comparison with any other member of the group.

One of the most unfortunate limitations of the median as a measure of central tendency is the fact that, unlike the average, it has no convenient index of the variability of the distribution about it. As a rough and ready index of the variability of the association times in each of the different series of fifty words, has been taken the smallest number of steps required to include 50% of the cases. Like the median itself, however, this measure takes no account for the extra long times but gives only an indication of how closely the central reaction-times are crowded together. In magnitude, this figure varies between 1.5 and 9 fifths of a second. As the time decreases with practice, the variability naturally drops also, although the record of Subject BLACK, in whom the

variability remains practically constant throughout, shows that it does not necessarily do so. The fluctuations in variability are more marked, and the individual differences less distinct, than in the curves of the reaction-times themselves. The variability of ORANGE is somewhat, that of BLACK, very disproportionately low. These are also the two most intellectual subjects in the group, although widely differing in their association types.

The distribution of the individual reaction-times in the single series of fifty words show a rather interesting fact that is contrary to what is ordinarily expected in such distributions. At no time during the practice is a distribution of marked skewness the rule. The mode is frequently as many as five steps away from the shortest reactions, and even during the final stages of practice there occur distributions exhibiting considerable skew towards the *long* end. Beyond the above decrease in variability, it is difficult to state any specific effect of practice on the form of the distribution. The natural interpretation of this is that an indefinite amount of practice would still leave us a considerable distance from the physiological limit of association time (which is more nearly approached in the controlled associations), and the limit of free association time, dependent as it is upon the most delicate interplay of the higher mental processes, is of too fluctuating a nature to leave any characteristic impress on the form of the distributions.

Contemporaneous with the free association experiment, the first five women subjects underwent practice in two other psychological tests. These were the Kræpelin addition test and a special form of the *A*-test, both of which belong to the general group of controlled association experiments. It is interesting to compare susceptibility to practice in these tests, which involve the continual repetition of the same or a few different associations, with the susceptibility to practice in the free association test, where the experimental task is a novel one in each individual observation. For present purposes it will suffice to compare the mean performance of the first two records with that of the last two for the period of twenty days. In the number-checking test it is more desirable to take the last two of the entire thirty days for which the function was practiced. This comparison gives us the following table:

FIGURES EXPRESSING THE PER CENT. OF PRACTICE IMPROVEMENT IN THE FREE ASSOCIATION, THE ADDITION, AND THE NUMBER CHECKING TESTS, INDICATING THEIR COMPARATIVE SUSCEPTIBILITY TO PRACTICE

(*The Lower the Figure, the greater the Practice*)

Subject	Free Association	Addition	Number checking
BROWN	80	61	52
RED	74	52	81
ORANGE	70	55	52
GREEN	61	61	55
BLUE	89	49	41

In the case of the physician (BLACK) the practice in free association was 75%. In these figures it appears that while the practice improvement is practically always least in the free association test, it is nevertheless of the same order of magnitude save only, perhaps, in Subject BLUE. This is a striking result in view of the essential differences in the experimental tasks. In the individuality of the successive situations it presents, the free association test is unique among psychological experiments. It affords small opportunity for making any given association path more open through frequent use. Such a conception of practice fails when applied to the results indicated in the present experiments. It is therefore a question how far the practice in the number-checking test and in the addition test is of the same type, and the product of the same causes, as that in the free association test. The essential features in the free association practice can probably be cleared up only through the most accurate introspection, although it is a very natural interpretation to conceive of it almost wholly in terms of a removal of inhibitions. These decreasing inhibitions can for the present be only loosely figured as a greater accustomedness to the experimental conditions, a lessened emotional reaction to them, feeling freer and more at ease, less liability to distraction, and the like. They are essentially conscious inhibitions, although it is not easy to describe them accurately unless one has had some practice in introspection. We can probably reduce all these factors to the general term of the *elimination of the inessential*. The part which is necessarily played by this *elimination of the inessential* in the reduction of free association time throws a not uninteresting side-light upon its possible importance in other sorts of practice, where, owing to the fact that there is more repeated traversal of the same association paths, we may tend to place the burden of explanation rather upon decreased resistance in the path itself.

So much for the practice effect on association time. With regard to any possible effect on the nature of the responses, may be first noted the number of times the same response is repeated during the same hundred words at the beginning and end of the practice. This per cent. of the repetition is calculated for the two series that were repeated, thus for the same stimulus words, and forms a basis for some striking comparisons. The per cent. of repetition before practice and after practice is as follows for the different subjects:

Subject . .	Black	Brown	Red	Orange	Green	Blue
Before Practice	8	11	14	16	17	13
After Practice	8	7	7	4	22	8

The regular tendency is to reduce the number of repetitions. In the case of GREEN the increase is essentially a matter of the subject's developing a "set" towards reacting with such responses as *large, small,* and *grand,* whenever they were available. With the exception of the physician, the remainder tend to particularize their responses more, as their practice in reacting gives them greater *Sprachfertigkeit.* It seems likely that BLACK, with his much greater initial *Sprachfertigkeit,* had already developed the quality that makes for decrease in repetitions beyond the point where practice would bring out any special change. The general trend towards greater particularization of the responses by practice, of which the decrease in repetitions is an aspect, will be discussed below in greater detail.

Further individual difference appears in the frequency with which a given stimulus word elicits the same response in both the initial and the repeated series, the figures on this point being as follows:

NUMBER OF CASES IN WHICH THE SAME RESPONSE WAS GIVEN BOTH BEFORE AND AFTER PRACTICE[1]

	Black	Brown	Red	Orange	Green	Blue
Average number of identical responses in the two repeated series	16	22.5	20.5	9.5	21.5	22.5
M. V. of this average . . .	2	2.5	4.5	.5	1.5	1.5

Save for the probably negligible incidence of the memory factor, the number of times in which a different response is given is in the nature of an indication of the adaptability of the individual's thought processes; that is, of the capacity for differential response in relatively similar external situations. This is somewhat complicated by the factor of special education, because an educated subject possess an artificial

[1] There are a few cases in which the stimulus word was not understood the same in the repeated as in the original series, but these are negligible for the results. While it is not strictly a practise phenomenon, it is worth quoting for comparison with the above. (Fuhrmann.)

capacity to differentiate his responses more than an uneducated one. Thus, as above, the physician again gives a relatively small number of repetitions of the responses under these conditions. But of the women subjects who have approximately equal education, ORANGE differentiates her responses a great deal more than any of the others, more even than the physician; and she is the same subject who made the greatest gain in differentiation in the previous table. It may or may not be a coincidence that this subject has been placed in more responsible positions, also credited with more than ordinary *resourcefulness* in her professional work. And however much one might naturally incline to stress the merely educational explanation of this greater differentiation of responses, one must never forget that superior education to a certain extent implies superior ability to acquire it, in the fundamental dynamic correlation between superior innate endowments, and superior opportunities for developing the powers which they confer.

For these differentiated responses, there then presents itself the question of whether they are differentiated along any particular lines; *i. e.*, of whether the response, besides changing in form and in content, tends also to change in association type.

Before attempting to consider any possible effect of practice on the form of association, it must be thoroughly understood that the ordinary means of classification are at best very subjective. Such categories as the *Sachliches Urteil* and *Werturteil* are wholly continuous, even though they may cover a considerable range, as from a commonplace predicate like *handkerchief—white*, to such a highly particularized reactions as *journey—distasteful*. These last are what Jung calls the "egocentric predicates." The same continuity exists, of course, between the Eingeübte sprachliche Verbindungen and the Sprichwörter und Zitate; thus one might with equal justice assign *citizen—Roman* to either group. The most unfortunate confusion, however, is that likely to arise between these language-motor responses and those from the upper associative categories. Every experimental series is replete with reactions where this vital distinction is itself largely a matter of "persönliches Werturteil." *Only—chance* and *never—settled* may be harmless Geläufige Phrasen or highly egocentric predicates. *Betray—criminal* may be a Subjectverhältniss, an Objectverhältniss or an Urteil; *spread—feast* an identity or a predicate; *lady—gentleman* an opposite or a co-existence. The stimulus *cart* may elicit the response *horse* through the medium of word-compounding, familiar phrase, or co-existence. Shall we call *itch—scabies* an identity,

a co-ordination, or a Kausalabhängigkeit? *Fun—loving* a Wortergänzung or an Urteil?

Such examples could be multipled indefinitely but are, perhaps, sufficient to show the character of the difficulties encountered in attempting an impartial classification of associative responses along the conventional lines. If available, reliable introspective data would go far towards removing them, but the very nature of the experiment usually renders this aid impracticable. With the more recondite responses, such classification is nearly meaningless. The interpretation, without reliable introspective data, of such reactions as *pole—legs, satisfy—savage, almost—conditional, enough—period, expect—to-morrow, justice—execution*, and the like, is little more than guesswork.

Subject to these reservations, then, the forms of association here justifying separate consideration may be enumerated as follows:

Description	*Approximately corresponding to Jung's*	*Example*
1. Failure of response	Ausbleiben des Reaktionsworts	.....
2. Egocentric	Egozentrische Reaktion Direkte Ichbeziehung	succeed—I must
3. Egocentric predicate	Egozentrisches Prädikat	lonesome—never
4. Judgment of quality	Werturteil	rose—beautiful
5. Simple predicate	Sachliches Urteil	spinach—green
6. Subject relation	Substantiv-Verbum Subjektverhältniss	dog—bite
7. Object relation	Substantiv-Verbum Objekt verhältniss	deer—shoot
8. Causality	Kausalabhängigkeit	joke—laughter
9. Co-ordination	Beiordnung	cow—horse
10. Subordination	Unterordnung	food—bread
11. Supraordination	Ueberordnung	rat—animal
12. Contrast	Kontrast	sunlight—shadow
13. Co-existence	Koexistenz	engine—cars
14. Identity	Identität	expensive—costly
15. Language—motor	Eingeübte sprachliche Verbindungen, etc.	town—state
16. Word-compounding or completing	Wortzusammensetzung, Wortergänzung	side—board
17. Pure sound associations	Reime	pack—tack
18. Syntactic change	Syntaktische Veränderung	deep—depth

The categories are divided into three groups. In the first group are those usually implying a special emotive element in the association; the second contains the more intellectual associations, while the very superficial associations are summed up in the third group. The associations from the present

material not falling into any of the above categories, it is impracticable to classify with any pretence of objective validity. They are also negligible in number, and indeed, several of the specified categories are very meagerly represented.

The tables indicate that in BLACK the type of association has undergone no particular change, except for trebling the number of contrasts, and halving that of the subordinates. The number of supraordinates, however, is remarkably small, which is significant in connection with this subject's superior education, and the tendency elsewhere for the supraordinates to decrease with practice. In BROWN, the responses show a slight tendency downward in the scale, and a considerable decrease in the supraordinates. In RED, this downward tendency of the associations is more marked, there being also a loss of half the supraordinates, which become mainly co-existences, these trebling in number. There are six of the third group of associations in the repeated series, to none at all in the original ones. And in respect to form of association, ORANGE again shows the most marked change of all. The predicates, many of which are quite egocentric in character, are decreased by about one-half, being relegated mainly to the language-motor, the word-compounds and the co-existences. There are also less than a third of the original number of supraordinates, these again becoming mainly co-existences and language-motors. Consequently these lower forms of reaction are greatly increased in number, there being 47 of them in the repeated series compared with 16 in the original. Notable is the total absence of contrast associations, also in Subject GREEN. The reactions of GREEN show no special change in type, except for the same decrease in the supraordinates, which here change to such responses as *large, small, grand* (as noted previously), technically predicates, but it is doubtful whether they are actually much more than language-motors. BLUE, however, shows a peculiar tendency to change the associations originally supraordinates to predicates of a higher order; *e. g.*, *donkey-animal, donkey-bray*. The lower categories are also better represented than at the start, so that the general result is to make the association type more variable than before. The remarkable shortness of the times in this subject will be remembered, and the responses themselves show rather greater superficiality than can be indicated in the classification.

In the totals, two main trends are apparent, which, however, cross, and to some extent mask, each other. First, the tendency, especially mentioned for some of the individual subjects, for the whole body of responses to move down in the scale of associations, and secondly, the tendency to greater

According to this system, it seemed that the associations in the two repeated series were most reasonably to be classified as follows:

CHANGE IN THE TYPE OF ASSOCIATION TO THE SAME STIMULUS WORD AFTER PRACTICE ASSOCIATION TYPE.

Subject	Black		Brown		Red		Orange		Green		Blue		Total before Practice	Total after Practice
	before	after	before	after	before	after	before	after	before	after	before	after		
1. Failure of Response	3				1				1				5	
2. Egocentric (Direct)			1	1									1	1
3. Egocentric Predicate	1	1	2				11	7					14	8
4. Judgment of Quality	4	3	1	2	5	3	14	5	19	20	2	6	45	39
Total													65	48
5. Simple Predicate	3	5	4	6	2	3	8	5	13	13	1	4	31	36
6. Subst. Vb. Subj.		2	1	1	2				1	1		2	4	6
7. Subst. Vb. Obj.	4	6	3	2	2	3	5	2	2	7	3	5	19	25
8. Causality	4	4	1	1	3	4		1	1	4	5	4	14	18
9. Co-ordination	22	26	22	21	19	21	9	13	5	8	15	17	92	106
10. Subordination	17	9	3	4	2	3	2	10	3	2	2	5	29	33
11. Supraordination	4	5	21	14	34	17	34	10	25	15	27	11	145	72
12. Contrast	3	9	3	4	6	6					8	6	20	25
13. Co-existence	14	10	10	13	5	16	9	17	2	3	15	10	55	69
14. Identity	12	12	27	25	19	18	5	5	24	22	18	19	105	101
Total													514	491
15. Language-motor	4	3	1	5		3	2	16	2	3	3	5	12	35
16. Word compounding or completing	4	3		1		1		9	1	1		3	5	18
17. Pure Sound Reactions	1	1											1	1
18. Syntactic Change		1				2	1				1	3	2	6
Total													20	60

Grand Total, 599 responses in each column. One stimulus word was unfamiliar to Subject GREEN.

particularization of the response as indicated mainly in the decrease of over 50 per cent. in the supraordinates. The latter is closely related to the decrease in repetitions described on page 7, for these repetitions consist largely of such supraordinate responses as *animal*, *food*, and the like, which have many subordinates among the stimulus words. For obvious reasons, these classifications do not lend themselves readily to further illustration of this tendency. It is plain what great individual differences there are in the amount of change of association type, but it is not easy to say just what ultimately constitutes these differences; they are not closely related to education. One is practically reduced to the tautology that as practice tends to lower the association type and to decrease the supraordinates, those individuals are most liable to practice effects who show the upper levels of association type, or a marked tendency to generalization in their responses. The *Sachlicher Typus* certainly shows the less change in association form, and probably also in reaction time.

The precise nature of these changes will perhaps be made clearer by the following illustrations. The comparative association times before and after practice are given, as usual, in 5ths of a second.

Stimulus word	Response before Practice	Response after Practice
	Greater Particularization	
ancient	man 11	and Honorable Artillery 10
bank	building 13	England 9
contrast	judgment 46	black and white 8
dog	animal 22	Airedale 16
engine	machine 10	Morris Heights 21
herald	king 8	Globe 7
little	child 16	statue 12
parlor	room 8	sitting-room 7
swift	runner 12	Mercury 17
wheat	vegetable 24	cream of wheat 15
	Greater Superficiality	
axle	hub 11	grease 6
axle	wheel 9	tree 6
bank	money 7	banker 5
discretion(twice)	wise 22, 42	valor 11, 6
lady	refined 21	man 19
pancake	tough 12	flour 9
shadow	shade 16	wall 6
spread	distance 17	bed 7
suffer	weak 11	pain 4
weak	frail 10	strong 13

In spite of the tendency to greater particularization, it is not unnatural, in view of these latter instances, that such actual "Komplexmerkmale" as are given in the reaction time, and in the form of the association as well as in the content of the response, should also be somewhat reduced by practice. The subjoined instances will serve to show what is meant, though some of the most striking examples of this tendency are not included.

Stimulus word	Response before Practice	Response after Practice
breast	face 22	milk 10
common	loose 14	Boston 8
flirt	disgusting 26	bird 9
heaven	peace 18	hell 6
person	woman 40	body 9
rat	ugly 27	large 10
sister	(Anna) 25	brother 7
virtue	good 18	reward 7
want	cherish 38	wish 9
whiskey	dangerous 13	Bourbon 7

The "complexual" character of the responses is apparently much diminished. This phenomenon should be attributable mainly to decreased emotive value in the stimulus-words, and only very sparingly to any greater expertness in dodging. In the above instances, the time is rather short for dodging, even though the occasion had presented itself. In this connection, it is well to bear in mind that special emotional reaction to a stimulus word may be a *product* of long association time as well as a cause of it, since the greater the tendency to hesitation, the greater the opportunity for emotive associations to be introduced. With greater facility of response, whether inherent or gained through practice, the importance of such a process is much reduced.

In brief, then, these experiments indicate the usual effects of practice on free association to be:

1. To decrease the association time to a limit approximating 6 fifths of a second for the median of 50 associations. At the beginning of practice, the subject may be any distance from this limit up to 15 fifths or more.
2. To further differentiate and particularize the responses, by increasing the readiness with which the subject's entire vocabulary becomes available for the purpose of such response.
3. To "flatten," or make more superficial, the form of association which the responses take.
4. To decrease the emotive value of the experiment, and consequently its applicability for all purposes involving its emotive value.

A PRELIMINARY EXPERIMENTAL STUDY OF THE CONSCIOUS CONCOMITANTS OF UNDERSTANDING

By HIKOZO KAKISE

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INTRODUCTION

When a word or a phrase is presented to an observer for a certain interval of time, it will awaken a succession of various events in his mind, such as inner reading of the word, "sense of meaning," suggested images of objects or of other words, and so forth, attended by various feelings and emotions. In the succession of these experiences, some will precede, others succeed, and still others occur simultaneously with understanding. The purpose of the study about to be reported is to examine, by a special method of experimentation, first the relations of the events preceding and succeeding to understanding, and then to investigate the nature of the simultaneous events, *i. e.*, the consciousnesses of meaning.

The method of experimentation was the same as that used by Marbe,[1] Messer,[2] Bühler[3] and others in their studies of thought, the so-called "*Ausfrage* experiment" by which

[1]Marbe, K.: Experimentell-psychologische Untersuchungen über das Urteil, 1901.

[2]Messer, A.: Experimentell-psychologische Untersuchungen über das Denken, *Archiv für die gesamte Psychologie*, 1906, Vol. VIII.

[3]Bühler, K.: Ueber Gedanken, *Archiv für Ges. Psychol.*, Vol. IX.

the total introspection of observers in reaction to words or phrases is taken down in the form of protocols upon which the conclusions are based.

Remarks on the Method: In spite of certain objections against the method from the side of certain psychologists, as Wundt, who calls it a "pseudo experiment" (*Scheinexperiment*) because it satisfies none of the four requirements of a psychological experiment, viz.: concentration of attention, repetition of the experiment, methodical change of the conditions, and the observer's own determination of the phenomena to be observed,[1] yet the present writer had recourse to this method partly as a kind of trial, and partly because there are no other methods which seem better suited to the present purpose. The reasons for this belief are: (1) That this method leads to division of labor, in that the experimenter and the observer are different persons, and thus permits the observer to observe the mental phenomena more freely than in ordinary introspection in which the observer and the experimenter are one and the same person and so attention must be divided between two different tasks, one active and one passive, which fact itself is of great detriment to the efficacy of introspection, especially when it has to do with merginal conscious experiences, as is the case with the present study. Galton[2] in his early experiments on association was surprised to find so many associations connected with a single word, when he separated the active and the passive attitudes by a special device. (2) As a comparative study, it is freed from any individual peculiarities or prejudices of the investigator. And lastly, (3) as the totality of the introspection is set down, it permits the investigator to take a fairer view of the position and significance of any particular element in the totality of the mental reaction than would be possible in any other way. This last characteristic brings this study into connection at some points with the three important studies of the present time, viz.: the study of mental types, the study of thought-processes, and the study of associations. The study of individual types deals principally with the individual differences of the means to understanding. The study of thought-processes deals with the direct conscious concomitants of understanding. And the study of association deals with the suggested conscious experiences after the understanding. Each of these studies considers only one section of the conscious concomitants independent of the others, all of which can be found in the preceding, simultaneous and succeeding concomitants of understanding.

The Technique of the Experiments

Three series of experiments were made in succession for the same purpose and mainly under the same conditions, except for differences in observers and apparatus and in some added elements in the third experiment.

Stimuli. The stimuli were words and phrases familiar and unfamiliar (or easy and difficult), concrete and abstract, mostly English or foreign. For abstract phrases proverbs were mostly used. For example: (familiar concrete words), snake, hand, mountain, etc.; (familiar abstract words) philosophy, psychology, fatigue, etc.; (unfamiliar concrete words) timbrel,

[1] *Psychologische Studien*, Vol. III, No. 4, Sept., 1907.

[2] F. Galton: Inquiry into Human Faculty and its Development. London, 1883, chapter on "Psychometry."

nostrum, nabob, etc.; (unfamiliar abstract words) pistology, oneirology, noumenon, etc.; (familiar concrete phrases) The sea is calm; The milk smells sour, etc.; (familiar abstract phrases) Union makes strength; Duty before pleasure, etc.; (unfamiliar concrete phrases) Long tongue, short hand; One man is no man, etc.; (unfamiliar abstract phrases) A sin concealed is half pardoned; Time enough is little enough, etc. A new kind of stimulus (meaningless visual stimulus), in the form of Chinese characters, was added to the verbal stimuli in the third experiment. The account and description of these will be given later (Part III, § 3).

Forms of Reaction. Two forms of reaction, an active (or short) and a passive (or prolonged) were used. In the active reaction the observer was asked to react by saying "yes" in the first experiment, and by pressing an electric key in the second and third experiments, as soon as he understood the word or phrase, and immediately afterward to report in the order of its occurrence the whole process (or as much as he could recall), which took place in the interval between the sensory perception of the stimulus and the reaction. In case he did not understand the stimulus the observer was asked to give in the same way his introspection as to what occurred in the interval between the perception of the stimulus and a signal which was given by the experimenter after the lapse of five seconds from the presentation of the stimulus. In the passive reaction, the observer was asked to remain passive without reacting, but to let the processes go as they would until a signal for ceasing (which was given by the experimenter this time at the end of three seconds) and then to give his total instropection for the interval as before.

Presentation of the Stimulus. Two ways of presentation were used: an auditory, in which it was spoken by the experimenter, and a visual, in which it was exposed.

Apparatus. The apparatus for the exposure of the stimulus and the measurement of the time in the first experiment was simply a set of cards with typewritten words and phrases and a stopwatch reading to one-fifth of a second. In the second and third experiments this simple apparatus was replaced by a more elaborate one constructed for the purpose. It consisted of three principal parts, *i. e.*, (1), an exposer; (2), a registering apparatus, and (3), a control pendulum. The exposer consists of a large board with an opening about in the centre, behind which stimulus-cards were exposed in turn by means of the rotation of a large wheel attached behind the board. Between the stimulus-card and the opening there was a sort of fan which closed the latter until it (the fan) was raised.

The fan was attached to one end of an electro-magnetic lever and was raised and lowered under the following conditions: (1), in case of the passive reaction, it was moved automatically by means of the control pendulum which made and broke the circuit to the lever, the circuit being kept closed, and at the same time exposed the card for an interval of three seconds; (2), in case of the active reaction, the experimenter moved

the fan by a make-key; and (3), in case the observer did not react, owing to the difficulty of understanding, the experimenter lowered the fan at the end of five seconds. Two mercury contacts at the free end of the lever made, and the reaction key of the observer broke, another circuit passing through an electro-magnetic marker which traced the reaction curves on the smoked surface of the drum of a Zimmermann kymograph. The marker of a Jacquet chronograph cut time units on the curve which could be read by one-tenth of a second. Between the fan and the opening there were two shutters or slides meeting at the middle of the opening when both were closed, and exposing one-half of the whole surface, when one was opened, which was done for words. With phrases both slides were opened. Special care was taken for the prevention of all distracting noises. In its rotation the apparatus made but very slight noise which was almost totally shut off from the observer by the large board of the exposer. The most comfortable position of the observer was obtained by the adjustable inclinations of the board and the height of the chair.

Observers. Of the 14 observers, 3 were Japanese students reading and speaking English fairly well, all others were English speaking people. The distribution of the observers and their qualifications were as follows:

Experiment I.		
	An.	Outsider.
	Cff.	Student of psychology.
	Gl.	Student of psychology.
	Hi. (Jap.)	Outsider.
	Kk. (Jap.)	Student of psychology.
	Kn. (Jap.)	Student of psychology.
Experiment II.		
	Ac.	Student of psychology.
	Ky.	Student of psychology.
	Sm.	Student of psychology.
	St.	Student of psychology.
Experiment III.		
	Ac.	Student of psychology.
	Ch.	Student of psychology.
	E. M.	Student of psychology.
	L. M.	Student of psychology.
	Sn.	Professor of psychology.

Remark: Several auxiliary experiments and minor tests with some of these observers and several others were made for special points. The description of these experiments has been omitted owing to the limits of space, and references only will be made to them.

Samples of the Protocols. The following are a few samples of protocols from among nearly five hundred thus obtained. They represent about the average length or amount of the reports, some being shorter and simpler, while others are longer and more minute. They are the reactions of three

observers, one from each experiment, to familiar abstract words, (A) by the active form of reaction, and (B), by the passive form. The stimulus-words for observer Cff., in the first experiment, were spoken, while those for others were exposed. Even by reading these few, which are typical in many respects, the reader may find traces of the general influence of these conditions upon certain of the concomitants.

A. Active Reactions

Fault. (I exp. word spoken; Obs. Cff. No. w. 20, time, 1. 5″.) ' 'While you were saying the first half of the word I wondered what you were saying. Then the sound lingered. And I got the consonant at the end, and the meaning at the same time. No image, but just feeling of meaning. There was a feeling of satisfaction and at the same time dissatisfaction. It is hard to analyse."

Peace. (II exp. word exposed; Obs. Ac. No. iii-5, time, 0.5″.) "Expectant attention keyed up owing to the delay of the arrival of the stimulus word. I read it in inner speech and grasped the word and relaxed. I grasped it at once in a very vague way, but at the same time with a feeling of assurance that I was right although I had very little of any imagery."

Psychology. (III exp. word exposed; Obs. Ch. No. iii-15, time, 0.5″.) "First feeling (of recognition of the form of the word) was followed instantly by the feeling of familiarity. There was no imagery. In this particular case it appears that the feeling of recognition and the feeling of familiarity are the same thing. There was n't any imagery, any attempt to define the word. I recognized the word. Absolute certainty."

B. Passive Reactions

Philosophy. (I exp. word spoken; Obs. Coff. no. w. 11.) "I got the apperception of the word at once. It came in connection with a recent little discussion with a fellow student on some question on philosophy. It occurred just this morning. I had just the sound of his name, very vague, and hardly any visual image of the place where we had discussed. Then I began to pronounce the name of 'Weber'. Also the word 'examination' was present. But no definite visual image of anything."
(Remark: The date of the experiment was shortly before the observer's doctor's examination and he was then reading Weber's History of Philosophy.)

Apperception. (II exp. word exposed; Obs. Ac. No. w. 36.) "Read it in the same way as before. I at once thought of Dr. Sanford in the lecture room giving the definition of the word. I had a vague visual image of him and the room."

Apperception. (III exp. No. iii—1, 16, word exposed; Obs. Ch.) "Pronounced the word. There was no feeling of effort, but just feeling of familiarity which came at once. I did n't put the meaning in words, but had simply a feeling of what it meant. Then I got a peculiar visual image of myself taking notes of the lectures in the classroom. The name 'Wundt' came into my mind in auditory form. The feeling was rather neutral."

On the Working up of the Protocols. These protocols were read with the following two points in view: First, the influence of the conditions upon the frequency of the concomitants. The conditions were divided into, *a*, material (*i. e.*, concreteness-abstractness of stimuli, etc.) *b*, experimental (whether the stimuli were exposed or spoken, etc.); *c*, individual (wheth-

er the observer belonged to the visual or auditory type, etc.). The primary or vital influences were taken chiefly into consideration though sometimes secondary influences were also considered. The second point was to examine the relative positions of the concomitants with reference to the understanding and to each other in the temporal sequence of their occurrence.

PART I

CONDITIONS OF THE PRECEDING CONCOMITANTS

These concomitants were reproductions of the sensory components of the stimulus word or phrase, *i. e.*, audito-motor reading and visual imagery of the stimulus. In ordinary introspection these events are often overlooked by many, as we are accustomed to attend only to the meaning and not to the means by which we reach it. According to their kind and frequency they have been sometimes used as criteria for individual differences. Sometimes they have been identified with meaning itself. In our experiments they were first to occur, following directly after the sense perception of the stimulus, excepting some cases with the visual reproductions which frequently followed, or occurred simultaneously with, the understanding. With easy or familiar stimuli the understanding followed immediately without any intermediary imagery. With unfamiliar or difficult stimuli there occurred often intermediary imagery such as the appearance of other verbal images in the form of synonymes, translations, definitions, etc., or suggested object images. As these were in their nature exactly identical with suggested images or those occurring after the understanding with easy stimuli we shall consider them later in Part II.

§ 1. AUDITO-MOTOR REPRODUCTION OF THE STIMULUS

Influence upon the frequency of audito-motor reproduction of the stimulus (i. e., the reading of the word in inner speech) when (a) the stimulus was exposed and (b) when it was spoken.

The influence of these conditions was so marked and definite that the results of the three successive experiments showed the same tendency and the influence of other conditions was almost negligible.

The total number of cases of this form of imagery in ten observers was 291 out of 311[1] or 93% when the stimuli were

[1] From this total, the first one or two (tentative) reactions by most observers are excluded. Also the reactions of four observers *An. Kk. Sm. St.* are excluded, for the reason that in case of the first two, the stimulus was spoken only. In the case of *Sm.* the tendency was not clear in the earlier reactions, with *St.* it was not clear in any of the reactions; about these see the succeeding accounts.

exposed; while it occurred in only 17 out of 176[1] cases, or 9%, when the stimuli were spoken. And these 17 cases occurred mostly when the stimuli were rather difficult or the pronunciation by the experimenter were indistinct.

We may conclude, therefore, that the inner reading of the word generally occurs when it is exposed, and occurs seldom when the stimulus is easy and spoken. In other words, the appearance and non-appearance of the reading of the stimulus in inner speech is primarily conditioned by the way of presenting the stimulus.

For the determination of the secondary influences affecting the frequency of this imagery, *i. e.*, influences arising from individual differences and from qualities of the material, some minor tests were made. The first thing to be mentioned is the fact that at the start the majority of our observers did not know about this tendency, but became aware of it after a few reactions, owing, perhaps, to the summation of the faint impressions occurring repeatedly at the same place, *i. e.*, at the beginning, in each reaction. One observer (*Hi*) belonging to a very pronounced motor speech type was not aware of this tendency at first, but a simple test of reading with the mouth open, etc., brought his attention, to his great surprise, to what he was actually doing. A lady (extra observer) who when asked about this tendency denied it, or was at least doubtful about it, was also surprised to find it after a simple test, and confessed that in her whole life she was never aware of it before. With another extra observer (*Ms*), to whom the presence of this tendency was doubtful, a test with simultaneous counting or speaking of a word showed that he could not read understandingly while they were continued. With two observers (*Sm*, *St*) who said they read by eye, the results of a test in the instantaneous grasping of a list of unconnected words or phrases showed no differences from other observers, either in the amounts of reproduction or in the ways of reading, *i. e.*, instead of grasping the whole at once at a glance they also read the words one by one in the same way as others. One of them (*Sm*), who denied the presence of this tendency in the reading of some phrases, found it later almost always with words. There was thus only one observer remaining who did not yet find in himself this tendency. No further tests with him have yet been made, so I cannot absolutely decide at present whether this process is really lacking in him or he is only

[1] This smaller number of spoken stimuli is due to the fact that in the majority of the second and the whole of third experiment the stimulus was only exposed.

not yet aware of what he actually does, but from the results of the test above stated and from the reports of many about the difficulty of the introspection of this tendency, the most probable supposition is that he is subject to it in spite of himself.

The distinction between the auditory and motor elements in inner reading our observers found it hard to make. But if we call the inner reading with the consciousness of the innervation or movements of the organs of speech motor, and the inner reading without these auditory, then there was at least one observer (*Hi*) who belonged to a pronounced motor type, like that of Stricker. With difficult words or phrases most of our observers went over to the motor speech form, and inner reading became pronounced. With familiar words of many syllables or with familiar phrases, mutilated reading was not uncommon. In the repeated reading, in inner speech, of unfamiliar and difficult phrases (mostly proverbs), reading with emphasis upon the principal words, or first a quick reading of the whole followed by a return to the principal words, was also frequent.

The conclusions suggested by these studies are: (1) that motor reading in the sense above defined is not universal as was believed by Stricker[1] and assumed by Max Müller,[2] but is limited to some individuals only, and with average individuals, to the reading of difficult words. (2) Auditory reading in the above sense, on the contrary, seems universal and necessary for the understanding of exposed words or phrases, which favors the view that the connection between the auditory and "concept centres" is immediate, while that for the other senses, *i. e.*, motor and visual, is indirect.[3] (3) Expressed in terms of conditions, the occurrence of auditory reading is mainly conditioned by the method of experimentation (*i. e.*, exposure), while that of motor reading is influenced by (1), the method,[4] (2) the material, and (3), individual differences.

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[1] Stricker: Ueber die Sprachvorstellungen. Wien, 1880. One of his tests is: "Keeping the mouth open and the tongue firm try to think the words papa, morning, stammer, etc.; If you do not succeed it means that a motor image is necessary to your inner speech."

[2] Max Müller: Lectures on the Science of Thought. 1887 (1st ed. 1883), Chicago. In his letter to Galton he unconsciously betrays his type in these words: "Yet if we watch ourselves, it is very curious that we can often feel the vocal chords and the muscles of the mouth moving as if we were speaking." *Ibid.*, Appendix, p. 8.

[3] *Cf.* Dodge: Die motorische Wortvorstellungen. Wien, 1896, p. 62.

[4] The writer thinks it very likely that even persons of pronounced motor type would not experience innervation or movements of speech-organs in the case of *hearing* easy or familiar words.

§2. VISUAL REPRODUCTION OF THE STIMULUS

Influence upon the frequency of visual reproduction of the stimulus when (a) it was exposed and when (b) it was spoken.

There occurred 30 cases of visual imagery of the stimulus out of 81 reactions with 3 observers (*Gl, Hi, Kn*) when the stimuli were spoken, and not a single case occurred in 61 reactions, with the same observers, when the stimuli were exposed. With two other observers (*Ac, Cf*) no case occurred—neither when the stimuli were exposed (71 reactions) nor when they were spoken (65 reactions). With the rest of the observers none occurred in 179 reactions to the stimuli which were exposed.

Of the three observers with whom this form occurred, two were Japanese. This naturally led to the suspicion that the frequency of this imagery for them might perhaps be the result of unfamiliarity with the English language, and not to individual peculiarity. This suspicion was, however, soon dispelled by an extra test with a number of Japanese words as stimuli which showed the same results; the only difference being that with Japanese words orally presented, the visual image of the stimulus was directly followed by understanding or suggested images, while with English words, the visual image of the stimulus was sometimes succeeded by the image of the corresponding Japanese word before the arrival of understanding or suggested images.

For instance: '*Traveller*'—(Obs. *Hi.*). "First I heard distinctly the sound 'travel'. There was a moment of hesitation and doubt. Then I saw the printed image of the word 'traveller' accompanied by the images of the Chinese characters, and at the same time full realization of the meaning. Then I saw mentally a traveller walking on Main Street."

The form and localization of the image were almost constant in the same individual. All three localized the image, usually at a distance of one or two feet in front. Two observers saw the image in handwritten form, the other in printed form.

About the frequency and conditions of suggested (associated) verbal imagery we shall see later.

These results lead to the conclusion: (1) that the visual image of the stimulus word occurs only occasionally when the stimulus is spoken, and scarcely occurs at all when it is exposed. (2) There are great individual differences in this experience as in the case of motor speech; in other words, this imagery is especially conditioned by the method of experimentation and individual differences.

The results of the above study in so far as they bear upon the validity of the customary method for the determination of individual types are, in certain respects, negative,

viz.: (1) We cannot wholly rely upon the questionnaire method in the study of types, because there are many people who are not aware of what they are actually doing. (2) Because the frequency of these speech forms primarily depends upon the manner of the presentations of the words, we cannot at once label an individual as, for instance, of the auditory or the motor type simply because he says that he pronounces when he reads or when he writes, etc.[1]

PART II

CONDITIONS OF THE SUCCEEDING CONCOMITANTS

When the stimuli were easy and familiar, the images of other words than the stimuli and the images of objects or events suggested by the stimuli, or, in short, what I might call "suggested images"[2] usually followed the understanding. When the stimuli were difficult or unfamiliar, they frequently preceded the understanding, but followed the images of the stimulus words or phrases. These cases of preceding suggested images I will call "intermediary images." All these images, the preceding, intermediary and succeeding suggested images, were of the same kinds differing only in their temporal relations to understanding.

All the suggested images which we need consider may be divided into two main classes, according to the nature of their constituents: (1) object images, which are the representations of, or references to, concrete objects or events; and (2) verbal images, which are the visual or audito-motor representations of suggested or associated words.

I shall begin with the succeeding suggested images or images following the understanding of familiar stimuli, and first with one of the object images, namely with memory images.

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[1] These considerations seem to be neglected by the following authors Patini, E.: Contributo allo studio sperimentale della formula endophasia. Napoli, 1907. *Cf.* p. 26, observation xlv, and others. Ribot, T. L'évolution des idées générales. Paris, 1897. *Cf.* Eng. tr. 1899, p. 114 ff. Max Müller. *op. cit.* Appendix p. 26. There in his answer to Romanes he wants to prove the universality, among all individuals as well as under all circumstances, of motor speech in thinking, by referring to special cases, and says: "How could I hold pronunciation necessary for thought when I am silent while I am reading, while I am writing?" When one listens, it is not necessary for understanding to pronounce each word.

[2] The term "image" is used here in the broadest sense including faint and indefinite experiences if they refer to concrete objects or events which can be in other cases distinctly represented. For instance, such experiences as, "I thought of that typewriter," or, "I thought of my buying a typewriter at a store about a year ago," etc., were also included as images though it is by no means clear in these cases what kinds of sensory imagery, (*i. e.*, visual, auditory, kinesthetic, etc.), were actually present. For further analysis of these experiences see Part III.

Experimental conditions. The numerical results given in the following discussion are from the records of reactions to familiar stimulus words (not phrases)[1] by the ten observers who assisted in the first and second experiments. Results from the third experiment, which confirmed those of the preceding ones, are sometimes referred to. The frequency ratios of various sorts of imagery are regarded merely as representing general tendencies or main proportions and not at all as expressing exact or even approximate relations. The total number of reactions to easy words[2] in the first and second experiments under the different conditions, whose influences we are about to examine, was 285.

§1. MEMORY IMAGES

By memory images here are understood those which refer to particular personal experiences with the objects or events indicated by the stimulus. They can always be localized in space (where) and time (when). They are sometimes called reminiscent associations.

Results of the Experiments. 1. This imagery not only followed the understanding, but also made the terminus of the reactions in which it was found, *i. e.*, other suggested images when they occurred generally preceded, and seldom succeeded, the memory imagery in the allotted intervals of the time, owing, perhaps, to the richness of contents or the vividness of the latter.

For instance: *Wheel* (passive, spoken stimulus, Obs. *Gl.* No. w. 22). "First thought of all kinds of wheels, blurred and indistinct images of multitude of wheels. Then the one I saw recently emerged very clearly in mental picture."

Vacation. (Passive, word exposed, Obs. *Ac.* No. w. 5.) "I read and spelt the word twice mentally. I thought of week-after-next and the work that I planned to do then. I think I thought of that because I have been recently thinking about the work to be done. And then I recalled the conversation I had in the Bloomingdale hospital a few minutes ago. Dr. C. proposed to meet his class next week. Some one said we had vacation then and Dr. C. had trouble to understand on account of his ear trouble.

[1] The results with phrases were not calculated for the following reasons: (1), The number of words used as stimuli, was greater than that of phrases; (2), there were no new kinds of suggested images found in phrase-reactions, those in the word-reactions and phrase-reactions being practically the same (Ribot found the same results; *Cf. op.* 114 ff.) the only definite difference being that with phrases the suggestions were more definite a matter which we shall consider later; (3), furthermore with phrases, not only the suggested images were less in number and more limited in variety but very frequently there occurred none at all, perhaps because the reactions took more time and energy than those with words.

[2] Ease and difficulty are only relative distinctions, some of the easy stimuli turned out to be rather difficult or unfamiliar ones to some observers. *Cf.* the remark under § 6 (Difficult stimuli).

The scene of the classroom was pretty vivid, and it was rather interesting, amusing."

2. This imagery in the case of passive reactions occurred in more than two-fifths of all the reactions of all the observers, the figures being 102 cases out of 242 passive reactions to easy words for ten observers with no considerable individual variations among them. The active reactions with easy words (not phrases) in the first experiment were in all but 37, made by three observers (*An, Gl, Kn*). In these 37 there were four cases of the sort of imagery now under consideration, all in the 15 reactions of observer *An* alone. The results of the third experiment, in which the majority was of active reactions, showed also very definitely that a memory image seldom occurs in active reactions. In all the cases in which it occurred, the observers reported it as occurring after the reactions or at any rate after the understanding.

3. Abstractness in the stimulus words had little or no influence on the frequency of this imagery in passive reactions to easy stimuli, or, if any, tended more toward inducing recent memory images than did the concrete words. Of 50 cases of recent memory images[1] out of 151 reactions in the case of five observers (*Ac, Gl, Hr, Kn, Ky*) 30 cases occurred with 74 abstract words and 20 with 77 concrete words with no considerable individual variations. The same general tendency is shown in the results with the rest of the observers. Likewise, whether the stimuli were spoken or exposed made no noticeable difference with the frequency of imagery of this sort.

4. Beside the passivity of reaction, the most important factor for the occurrence of this imagery was the recency of association. (a) Out of 106 memory associations in 285 total reactions 82 were recent associations or reminiscence of events falling within a period of not more than one or two years previous, 21 of remote associations, and only 3 of boyhood associations.[2] (b) Quite insignificant and accidental associations, alone, without any emotional excitation or logical connection or repetition, by sheer power of recency, occurred frequently, pushing other images aside.

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[1] These were the most frequent of all memory images; for details, see the sections to follow.

[2] These results rather contradict those found by Galton. The numbers which he found were: boyhood associations 48, manhood 57, while "quite recent events" had only 19, in his four times repeated experiment with 75 words. These are, of course, the combined results of the pure revivability and the fixity or tenacity of associations as they were repeated. But even in his series of the first reactions the frequency of recent associations is quite low. *Cf. ibid.*, p. 195.

For instance: *Ink* (Obs. *Ky*), "Pronounced the word. Idea of the blackness was the first thing. Then I thought of those ink-blotters I got this morning at a down-town store. There was a vague image of blotters. I had also clear image of my fingers being dabbled with ink which occurred a couple of days ago."

Vacation. (Obs. *Sn.*) "I think I saw the middle of the word and noticed the syllable 'cat'. Then I read the whole word to myself. I think I had an incipient pronunciation of it in inner speech. Then I remembered that this word was the word which Dr. Bolton read when we came here yesterday. I didn't get any definite image except that association. I just thought of it, an idea of direction rather than a visualization. That idea of direction is very frequent with me as the first thing to come in case of such an association as that."

(c) With such words as *vacation, memory, fatigue, pedagogy, philosophy, apperception*, etc., which were purposely selected and used in the third experiment (mixed among other words), the observers had in nearly all reactions, in spite of the abstractness of the words, a concrete image in the form of a recent memory association which the experimenter could often predict from his own share in the same recent and repeated experiences, *e. g.*, the images of certain professors, the class-rooms, certain authors, etc.

For instance, *Apperception* (Obs. *E. M.*). "First slight tension and action on the motor side with the pronunciation of the word. Then the meaning came, but there was an effort to get the psychological meaning. I had a rather clear visual image of pages in Wundt's 'Outline of Psychology' in which the thing is treated. And then the visual image of Dr. S. in the lecture room and also some auditory image of his voice."

Pedagogy. (Obs. *Sn.*) "I was not quite ready. I read the word in inner speech but not very loud, and was not quite sure whether I read it correctly. So I read it again and I had a faint feeling that I knew the word. Then I thought of the direction of Dr. B's room and probably had also a very vague suggestion of Dr. B. himself. The consciousness of direction was very clear. I had the word 'teaching,' probably in inner speech."

Remark. Ribot's "thinking by analogy" by which he means such reactions as "I thought of Hume's theory of causality", for the stimulus "*cause*"; or the recalling of "Littré's definition" for the word "*Justice*", and so forth (*ib.*, 114 ff.), is merely our "memory imagery," and cannot therefore be regarded as a special mark of individual differences. The whole matter rests upon the duration (slowness or quickness) of reactions. Besides, with these familiar words, and especially in scholars, the understanding of what the words mean precedes any suggested images, so that such memory images are not means to understanding but the results of natural and spontaneous associations.

§ 2. INDICATIVE IMAGES.

For the lack of a better name, I have called "indicative images" those which referred to particular objects found in the

room at the time of the experiment. For instance: *Typewriter*, I thought of that typewriter on the table. *Experiment*,—I thought of this experiment, etc. In their psychological nature, a strict line of demarcation between this sort of imagery and recent memory imagery is hard to draw as the one gradually passes into the other; yet I found a separation, by the conventional definition above given, necessary in the treatment of the results for, in the first place, the frequency of indicative magery was markedly more pronounced under certain conditions than that of memory imagery; and in the second place, it seemed to be influenced by a new factor soon to be mentioned. So that, when, for example, the word *Entrance* suggested to some observers the aperture of the experimenting apparatus, and to others the door of the experimenting room, while to a third the gateway of the university or that of the library, and to a fourth the entrance to the court house of this city, and to a fifth the entrance to the capitol in Washington and finally to a sixth some front steps leading up to *a* building, I put the first two into the category of the indicative imagery, the third and the fourth into the recent, the fifth into the remote memory imagery and the sixth into the general visual object imagery described later on.

Sometimes one and the same response, therefore, may become the one or the other of these types of imagery according to circumstances. For instance, with the word *Seminary*, if one thinks of Dr. H—'s seminary, or Dr. S—'s or Dr. B—'s, it will be a case of indicative imagery when the word was given there, while it will be recent memory imagery when the experiment was performed at some other place, and remote memory imagery when it was made years after the personal experiences of the observers.

But a very small number of appropriate stimulus words for the arousal of imagery of this sort, such as *room, window, entrance, watch, hand, typewriter, experiment*, etc., happened to be found in our list of stimulus words. Nevertheless the following tendencies were rather definitely brought out. 1. The occurrence of imagery of this sort is primarily conditioned by a special kind of stimulus words which I may call "indicative words," such as those just mentioned. 2. With these words this imagery occurred in far greater number of cases when the words were spoken than when they were exposed, the frequency ratios being respectively 89% and 19%. Further inferences with reference to this sort of imagery are impossible from the data at hand, but the following one is also suggested by the results, namely that this sort of imagery is determined by a new factor which I might call "implicit context"; in other words, the spoken stimulus word becomes

virtually in its effect a phrase especially adapted to induce imagery of this kind. In daily life we are accustomed to react to a singe word under such circumstance when the object indicated by the word is near at hand and the speaker wants something to be done with the object. A single uttered word then is, in fact, an imperative sentence, meaning, for instance, 'Please give me that thing', or 'Look at it', etc., and the person addressed turns his attention instinctively to the object mentioned. Now in the experiment when an "indicative word" is uttered the observer falls unconsciously into this attitude, because of the similarity of situation; while, when it is exposed, this link of habitual associations becomes broken, whence the less frequency of this sort of imagery.

In the temporal order of occurrence, this imagery was, in general, the promptest of all suggested images, occurring immediately after, or sometimes simultaneously with, the understanding.

Remark. In this kind of reactions, which were, as a rule, rather reflex, the full realization of the meaning, such as richness of concept, came often later than the arrival of this imagery, though the understanding of the word in the sense of recognition obviously preceded it. To these varieties of meaning we shall return in Part III.

§ 3. ORGANIC IMAGES

Under this term I understand a reference to, or becoming aware of, the organic sensations or feelings either produced directly or revived, which are habitually associated with the words. The term organic sensations is used here in its broadest sense, comprising kinesthesia or sensations of muscular movements or innervation, as well as sensations attending the conditions of internal organs.

For instance: *Excitation:* (*Ac*) "Read it in the same way. I tried to state it in the sense given by Wundt. Then I tried to think about the psychological evidences of excitation, and simulated to myself its bodily state unconsciously." *Rain.* (*Ky*) "First pronounced the word inwardly. Next there was a visual image of raining just outside of this window (of the experimenting room). There was also an idea of wetness just in the form of bodily sensation in which no visual or auditory elements were discernible."

Results. 1. This imagery occurred in a very small number of cases. 2. It occurred only, (a) with a special class of stimulus words suggestive of this imagery or what I might call "Organic words", with which the organic associations (or components) more or less predominate, such as, *respiration, suffocation, fatigue, uneasiness*, etc., and (b) with passive (or prolonged) reactions. 3. It seldom occurred alone but

usually accompanied by other suggested images, such as verbal and visual imagery. In cases of its concurrence with these images it usually succeeded the latter, *i. e.*, it was less prompt in its occurrence than visual and verbal suggested images.

§4. GENERAL VISUAL-OBJECT IMAGES

These images, instead of referring to any particular object or event of past experiences like memory images, represent, predominantly in visual terms, merely types or concrete examples of objects designated by the stimulus words. For instance, *Box*—I had a visual image of *a* wooden box. This is a case of simple object imagery in which only a single object is represented. It occurred often that many objects belonging to the same class were visualized simultaneously or in quick successions, producing what I may call "complex object imagery." In such cases the visualizations were, as a rule, faint and incomplete. For instance, *Animal* (*An*)—I thought of all sorts of animals moving alive, etc. *Vacation* (*L. M.*)—(I had a very rapid visual impression of landscapes. The ideas or faint visual images of a whole summer.

Sometimes these general visual images, which as a rule preceded memory images, turned out to be the first stage of the latter, in the same way as free associations are sometimes traced to particular incidents. For instance, *Cross*, (*Ac*) — When I heard the word, there came at once the picture of a crucifix. It seemed to be traced to those pictures of crucifixes which Dr. H— showed us in his lecture on Christ. It impressed me at that time.

Results. 1. There were great individual differences in the frequency of this imagery, ranging from zero to 53%, in the percentages for the ten observers. 2. In the case of this imagery, reversing the case with memory imagery, the concreteness and abstractness of the stimulus word influenced the frequency of the imagery in a marked degree, the frequency with concrete words being nearly three times as great as that with abstract words. 3. The frequency of imagery in all the reactions was 51 cases in a total of 286, falling thus far below that of the memory imagery, but rising far above that of the organic imagery. 4. In cases of concurrence this imagery always preceded memory imagery.

§5. SUGGESTED VERBAL IMAGES

By a "suggested verbal image" is meant here a visual or audito-motor reproduction of a word associated with the stimulus-word. It must be distinguished, therefore, from the verbal imagery of the stimulus word itself the conditions of which were treated at the beginning of this paper. Suggested

verbal imagery may occur either with or without corresponding object imagery, *i. e.*, dependently or independently. All independent imagery which appeared in our records was in the nature of either sensory or conceptual associations (*i. e.*, those having a sensory or a conceptual relationship with the stimulus words). In sensory associations we found only "klang associations," or associations by the similarity of sound. In conceptual associations there were roughly three kinds: 1, synonyms, 2, contrasts, and 3, co-ordinations, subordination and superordination. For instance (co-ordination) dog—cat; (subordination) city—New York; (superordination) cat—animal.

Results: 1. There were very marked individual differences in the frequency of this sort of imagery, as in the case of general visual imagery, the ratio ranging from zero to 100%; for instance Obs. *Ac.* had no cases of this imagery in all his reactions, while Obs. *Sm* always had it. Some observers had a few cases, others many. 2. The frequency of this imagery like that of general visual imagery was also markedly influenced by the nature of the stimulus word (abstractness or concreteness) and in this case in inverse relation. It occurred three times as frequently with abstract words as with concrete words. 3. As to "klang associations" there were only three of them in all the reactions, and only in the case of one observer (*Sm*), so that this form must be regarded as rather exceptional, at least with easy stimulus words. (Of the frequency of this form with unfamiliar words we shall speak later.) We had now and then phrase reactions from four observers most of which appeared in the form of definitions of abstract scientific terms. Conceptual associations in the form of synonyms, etc., however, made the majority of the cases. 4. As to the time of occurrence: With independent imagery, it was one of the quickest to occur; in case of concurrence with other images, it generally preceded the general visual image and the memory image. With dependent verbal imagery, the time depended on that of object imagery which the verbal imagery accompanied.

On the Tracing of Verbal Imagery

With independent verbal images the observer in the majority of cases could not give introspectively any account of their origin owing to the lack of conscious background.

For instance, *Excitation*: (Obs.*Sm*) "Pronounced. The word *psychology* came which was pronounced and visualized in typewritten form. Then I saw the German word *Erregung* printed in black. Then in inner speech I said 'I wonder why I selected these words.'"

This imagery though difficult to be traced subjectively is yet

easily traced objectively in the sense that it can be easily brought under conceptual or logical classifications. The dependent verbal imagery, on the contrary, is easy to trace subjectively and hard to trace objectively.

Suppose the observers reacted by uttering just the dependent verbal images in response to the stimulus words (without giving their total introspections) and then the experimenter or any outsider attempted to trace them objectively, as best as he could. Then compare the results obtained by conjecture with the actual connections found in the total introspections of the observers. Such a comparison is easily made by placing all such verbal imagery found in the protocols directly after the stimulus words. For instance, *Horse*, (Obs. *Cf.*) [suggested verbal images] "The name of a friend of the observer" and "horse."

Introspection: "The sound of your voice lingered. Then there was a sort of general idea. Then a rather pleasurable feeling due to the recognition of a favorite animal. There was a complex vague association there, such as a vague notion of a useful domestic animal. Then I had a visual image of being on horseback, with a sort of inner speech in auditory terms, going riding with a friend of mine who suggested it to me. I heard or pronounced his name and also the word 'horse' pretty distinctly. The localization of the scene of the riding was far down in the direction he (my friend) has suggested. The suggestion of his occurred but two days ago."

Turkey, (Obs. *Sm.*) "Bronze." Introspection: "First strong visual impression of the typewritten word and its color. Then came the word 'bronze' in the form of inner speech and at the same time a rather imperfect image of one of those big bronze colored turkeys. The color was more distinct than the outline. Not well localized, hovering somewhere around in the air. The color came out distinctly, the shimmer of the iridescent color. Considerably later, *i. e.*, after the shutter was closed, there came the thought that wild turkeys were once abundant in New England, but now almost extinct. Then came the idea of Thanksgiving, but not well defined, just a general idea of festivities."

§6. IMAGES WITH UNFAMILIAR STIMULI

It is known in a general way that the grades of acquaintance, *i. e.*, familiarity and unfamiliarity, with stimulus words or phrases have an important influence on the modes of reaction. Here we propose to examine in particular their influence, especially upon images.[1]

By unfamiliar stimuli is meant here those words or phrases in the case of which understanding either did not occur directly (soon after the sensory reproduction of the stimulus) or did not occur at all.

The criterion is thus totally subjective (*i. e.*, according to the observers' modes of reaction) though a number of so-

[1] Their influences on the "feelings", we shall consider later in Part III.

called unfamiliar as also familiar stimuli[1] were provisionally fixed and used by the experimenter.

Some of these objectively fixed unfamiliar stimuli were naturally, by some observers, found to be familiar and some of the objectively fixed familiar stimuli were found by other observers to be unfamiliar, so that the following account of the influence of unfamiliar stimuli is taken from the results of all experiments (as we have seen in the treatment of the images of stimulus words).[2]

Results. The following results show that there is a striking similarity in the conditions of some images which attend the reactions to unfamiliar words and of those attending unfamiliar phrases.[3]

The influence of unfamiliar stimuli upon the the images (auditory, motor, and visual) of the stimulus-words, such as their increased frequency, accentuation, repetition, etc., we have already seen in Part I, § 1. The tendency to such imagery already exists in normal reactions, and merely becomes accentuated in difficult reactions owing to the retardation of understanding.

A more important and characteristic influence of an unfamiliar stimulus is its awakening of intermediary (or, preceding suggested) images which were 1, klang-associations, 2, paraphrases, 3, memory images, and 4, synonyms.

1. *Klang-associations.* With absolutely unfamiliar words there occurred quite frequently klang-associations. In the case of some stimuli, different observers had often the same associations: such as, *nosology—nose, mousquetaire—mosquito, pistology—pistol, hyle—hyla, cabala—cable, timbrel—timber, timbre—timber, synergism—syllogism, monad—Monadnock* (a mountain in N. H.), etc.

Examples. *Nosology:* (Obs. *L. M.* III—i, 5). "The pronunciation suggested 'noseology'. Then I found myself saying, 'nose-ology', which made me laugh. The mind was blank. I hadn't any effort or tension, but rather relaxation. I had a feeling of the amusing, comical."

Nosology. (Obs. *Ch.* III—i, 5.) "First feeling of total unfamiliarity. But this unfamiliarity was a little bit different from the first one because I recognized the first part of the word. I pronounced it two or three times. The word first suggested nose and made me think of a science of the nose, which I knew, of course, was not the correct meaning of the word."

Hyle (Obs. *L. M.* III—i, 1). "I got no reaction. I just found myself saying 'hyla', 'hyla'. There was a great deal of tension."

Hyle (Obs. *Sn.* III—i, 1). "I was attending to the movement of apparatus just before. Then as soon as the word appeared I pronounced it men-

[1] For examples, see Introduction.

[2] Part I, §§ 1 and 2.

[3] Ribot states that he found practically the same conditions of imagery in both word and phrase reactions, and so dismissed the latter in his later experiments. *Cf. op. cit.*, p. 114 ff.

tally several times. My first thought was that it was connected with hyla, a tree-frog. And then I read it again and thought you gave it because of its philosophical meaning—the word is the same as the Greek ὕλη which would be spelt in the same way. And after that I repeated it several times and was repeating it. There was feeling of concentration particularly marked."

With unfamiliar phrases, however, this form of association by similarity of mere sounds, perhaps something like parody, did not occur.

2. *Paraphrase.* With unfamiliar and apparently compound words, it was a common tendency to analyze them first into familiar elements and then to make out the meaning of the whole. For instance, *synergism:* syn-energy "working together", *ultramontanism*—ultra-mont-ism= "doctrine beyond the mountain"; *pachydermata:* pachy-derm-ata= "a class of thick-skinned animals"; *Millenarism:* Miller-ism= "a doctrine of Miller," etc.,

Example: *Millenarism.* (Obs. *Ch.* III, ii, 17, Time—(—.[1]) "Read the word through half a dozen times and at the last time I divided the word into two syllables. Feeling of effort throughout the whole experiment; tension and the same feeling of hunting. The suggestion that came to me was a man named Miller who had a peculiar theological doctrine something about the end of the world at a certain time, I think. And so the feeling was not a feeling of total strangeness, but it was a feeling of recognition of the word. I suspected the word was probably constructed after the name of that man and stood for his system. Feeling of unpleasantness attached to the strain. Feeling of uncertainty and ignorance. The mind is not yet quite free from work. There seems something still working."

Pistology. (Obs. *Sn.* III, ii. 7, Time—(—[1].) "Read the word in inner speech and tried to think of what it could possibly mean. I had that feeling of strain, of unfamiliarity, and then I began groping about. I looked at the first part of the word and recognized the word 'pistol' there, and then, I think, I formulated it in inner speech as 'the science of pistol.' And then I rejected that. At the same time there was some sense of humor. Then the words 'science of fishes' came perhaps by way of analogy with the word 'piscatology' (this word did not come into consciousness). But I realized that that is not the meaning of the word. And so I was still trying further and was thinking that I was not able to make out what the word was when the shutter was closed. A feeling of unfamiliarty, and a feeling of groping about for something were there, but the feeling of unfamiliarity was the only one which was in the centre of consciousness. There was also a certain feeling of helplessness though not clearly developed. These feelings of strain and effort passed off more gradually this time than in the other one. There was a little curiosity whether it was not a nonsense word."

With unfamiliar and difficult phrases, this tendency to paraphrase was more frequent and common than with words. An important feature is the fact that here two kinds of intermediaries, a verbal and a visual, with rather definite individual

[1] The sign "—" signifies that the understanding did not take place within 5 seconds. For details see Introduction.

differences, were pretty clearly brought out. In the case of the verbal intermediary, the mind works mainly with synonyms, for the principal words in a phrase, or with inner speech in the making out of the meaning. There is seldom any trace of visual images of objects.

For instance: "*Truth seeks no corner.*" (Obs. *Ms.* ph, 4. Time—) "Read it in the same way as before. Turned back to the two words 'truth' and 'corner'. I had no visual image. From the word 'corner' the words 'square place' came by association. Interpreted 'Truth spreads itself.' There was a slight feeling of effort or tension. The mental operation stopped with the understanding."

"*A sin confessed is half forgiven.*" (Obs. *Cf.* I, Ph. 7, Time—.) "A little doubt still remains with this too. Some almost audible inner speech with distinct articulation and movements. A rapid comparison with the last one but no pronunciation of it. Everything was almost auditory, *i. e.*, words dealing with an imagined sin of a child who confesses to his father some fault he had done. That kind of thinking or imagination seems to bring forth the meaning, namely: 'If you tell him about your wrong yourself, it wakens the good disposition of the person you have offended'."

In the case of the visual intermediary, the mind works mainly with more or less vivid visual images of objects designated by the principal words of a phrase, or with visual imagination, in the making out of meaning.

For instance: "*Riches have wings.*" (Obs. *Kn.* I, Ph. 3, Time—.) "Internal reading. Then I had a very clear image of a bird with wings. Then the image of the flying away of the bird, which brought the idea, not image, of the going away of riches. Then the feeling of the conviction that the problem was correctly understood. This feeling was accompanied by a peculiar feeling of relaxation and ease."

"*Truth seeks no corner.*" (Obs. *Hi.* I, Ph. 4. Time—.) "Inner reading with movements of speech organs as before. I imagined and constructed a square in my mental vision. Then smoothing the four corners of the square I shaped it into a circle, and got the following interpretation. 'Truth is perfect.' (After having reported his introspection, the observer confessed that he began to doubt about his interpretation.)

With some few observers the use of one of these types of imagery was so constant and so firmly established that they seldom went over to the other form, regardless of the concreteness or abstractness of stimulus.

An extra observer had visual (or concrete) intermediary imagery nearly all the time as shown in the following protocol:

Obs, *Osb.* Ph. No. 1. (*Union is strength*) 3" (stimulus spoken). "Saw white grasping hands, immediately followed by the recollection of the scene of the bridal ceremony in Longfellow's 'Launching of the Ship.' Then I had the sense."

Ph. No. 2. (*Use makes perfectness*) 3" (spoken). "I had a mental image of each word in the sentence. The style of letters appeared in the form between printed type and handwriting. Then followed the visual image of a vague shadowy human figure. Then the meaning.

Ph. No. 3. (*Riches have wings*) 4" (spoken). "Spoken sound remained. I had a mental image of hunting, and saw the white wing of a bird. Then the meaning flashed in.

Ph. No. 4. (*Truth seeks no corner*) 1' (spoken). I had an image of a corner. There was no repetition of the heard words. I payed very little attention to the words. The sense flashed.

Obs. *Cff.* on the other hand, had verbal imagery or inner speech in most occasions in the understanding of unfamiliar phrases.

Several of the other observers approached, in varying degrees, to one or the other of these extreme cases, while the rest represented the middle or neutral class, having no special preference or inclination to either sort of imagery. It was the imagery of this last class that was influenced markedly by concreteness or abstractness in the stimulus.

Here we have, therefore, in these images a pretty definite and also rather important criterion—important because it directly concerns the thinking — for individual differences. The general tendency seems to be that the frequency of verbal and visual intermediary images corresponds nearly to that of verbal and visual suggested images in cases of easy understanding.

3. *Memory images.* If the words or phrases were such as had been experienced once, or a few times, before, memory images often occurred in the form of the recollection of the circumstances under which the words had been experienced, regardless of individual differences and of the concreteness or abstractness of the stimulus words. This kind of memory images usually preceded the understanding, but sometimes succeeded or occurred simultaneously with it.

Example: *Synergism.* (Obs. *E. M.* iii—i, 10.) "First a visual impression of the word, then the pronunciation of the word. Then I saw vaguely the place in a book where the word was treated, but the meaning did not come to me. There was quite a noticeable feeling of strain on account of my hard effort to recall the subject of the treatment in which the word appeared."

Noumenon. (Obs. *Ky.* II, w—19.) "First the tendency to pronounce. Then the realization that it means the opposite of phenomenon came. It reminded me that I looked up that word in the dictionary about two months ago. I had a distinct visual image of the place; I had been looking at the dictionary in the library."

Thinking is so hard that many prefer judgment to it. (Obs. *Ac.* III—iv, 9, Time—3.0".) "I read it and the meaning flashed into my mind at once. But it was just a feeling. Then I had a very vague image of the lecture room and of Dr. S. I felt the statement to be easy and reacted. After I had reacted, in second thought I found it was not sure. The reason of the occurrence of this image is that Dr. S talked about the difficulty of thinking in common people who would rather decide without thinking. I did not recall the idea of it very clearly, whence my hesitation afterward. The tension was only kept up while I was reading and considering. With the reaction it went away and some sense of satisfaction came with it. But it was soon dispelled by the sense of uncertainty and its accompanying feelings which persisted as in other cases of difficult reactions.

The frequency of such memory imagery, with not quite familiar words or phrases, is well known to every one of us especially in the study of a new language. With frequent repetitions these definite associations fall away giving place to mere feeling of recognition or of familiarity.

4. *Synonyms. A. With words.* With rather, but not quite, familiar words, there occurred sometimes other more familiar verbal images having similar meanings, or synonyms in widest sense. They were synonyms proper, definitions, and translations.

a, Synonyms proper, or words having similar meanings.

Apperception. (Obs. *St.* II, w—18.) "There was a slight surprise. The word was familiar. It brought the word 'attention'. Then I thought of Dr. S explaining the meaning of the word as mental grasp of the whole. I visualized Dr. S in his recitation room."

b, Definitions: This form occurred especially with technical terms, such as, apperception, parallelism, noumenon, etc.

These forms occurred mainly in observers belonging to the verbal type. The observers belonging to visual or concrete type visualized, in such cases, a concrete instance mostly in the form of memory imagery.

For instance: *Parallelism.* (Obs. *Ac.* II, w—32.) "I spelled and pronounced the word mentally. I saw mentally Dr. S drawing on the blackboard the diagram on parallelism, and speaking of the theory, of the statement of the relation between body and mind."

c, Translation. With foreign words this form frequently occurred regardless of individual differences.

Color. (Obs. *Kn.* I, w—10.) "Sound continued. Translated into Japanese 'iro' which was internally spoken. Then the understanding, and I thought of the red color of this card-box on the table."

B. With phrases. With unfamiliar phrases there occurred similiar forms of synonyms nearly in the same way as in the case of words.

a, Similiar phrases.

Example. *A chariot will not go on a single wheel.* (Obs. *Cff.* I, B—I, Time—.) "I tried to recognize the phrase, but failed. Then I recalled a similar expression, 'A college without a library is like a wagon with three wheels.' The situation in which I had heard the proverb came into my mind. I had a slight vague image of a chariot as described in a book. Then I tried to compare two wheels to two qualities in a person's nature, which balance each other. The word 'balance' was internally spoken. I decided that the only meaning I can get out of it was that 'Balance is necessary for success.' The sentence was internally spoken. Feeling of dissatisfaction with reference to my explanation. A feeling that something is wrong with my interpretation."

The translation of foreign phrases was quite common.

For instance: *Laborare est orare.* (III—ii, 6. Obs. *Ch,* Time, 1.9″) "First read it through and understood it without translating it. The under-

standing was not complete, so I read it second time translating into English and I got the sense. I experienced two sorts of certainties, the certainty about my knowledge of the Latin words, that is about what they mean in English, and that of the sense. I was at the beginning a little surprised to find a Latin phrase."

To conclude: Unfamiliarity with the stimulus has an important influence on the frequency and kinds of images. 1. Unfamiliar stimuli accentuate the images of the stimuli in general. 2. Intermediary images in the forms of klang-associations, memory images, synonyms, translations, definitions, etc., are direct results of unfamiliarity. 3. In the paraphrase, there is a marked tendency to individual differences in the use of verbal and visual intermediary images. 4. The kinds and conditions of intermediary images both with unfamiliar words and phrases seem, in the main, nearly the same.[1]

§ 7. AUSFRAGE METHOD AND THE CUSTOMARY METHOD IN STUDIES OF ASSOCIATION

The results of our study lead to the belief that the Ausfrage method, such as was applied in the above study, is more adapted, in its passive form of reaction, to the study of the actual phenomena of association than the customary method of the so-called association-experiment, because it has the following advantages over the latter: 1, Naturalness of associations; 2, Clearness of the term suggestion; 3, Introspection; 4, Change of conditions. The customary method lacks almost all these conditions essential to the study.

1. *Naturalness of associations.* The observer has only to remain passive to the stimulus letting the associations or suggestions go as they occur without interruption or disturbance by will. With the customary method, on the contrary, the course of associations becomes complicated or jeopardized in a double way: 1, By the observer's mere intention or will to fulfill the artificial requirements of the experiment, and 2, by the actual fulfillment, of them. *a*, The reaction must be given in one word; *b*, The reaction-word must be different from the stimulus-word; *c*, The reaction-word must stand for the first association; *d*, The reaction must be as quick as possible. It is clear that the mere idea of fulfilling these numerous requirements is itself sufficient to change the observer's attitude from a passive or neutral state to an active or selective one. As to the results of actual fulfillment of requirement *a*, it may be asked how, in case the observer has as an associated idea, a complex visual image or memory

[1] For the conditions of concomitant feelings see Part III, § 3.

image, he could express them in a single word without selecting at random the name of one of the represented objects or a part of one or some idea such as could be promptly expressed. Of requirement *b*, it may be said that the association existing between an image and its name (as well as that between a perception of an object and its name) is one of the strongest; and the two operate reciprocally; a name usually calls up its object-image and the object-image usually calls up its name. When a name calls forth its object-image in the observer's mind, the natural tendency is to name it again. But this tendency must be checked, for a reaction by repeating the stimulus word is forbidden, though, in such cases, it is psychologically quite different from mere mechanical repetition or imitation of speaker's voice. The result of the fulfillment of the requirements *c* and *d*, *i. e.*, of "the first association" and of "promptness," is that the majority of reactions will necessarily consist of independent verbal associations or what Wundt calls articulatory or pseudo-associations (*Scheinassociationen*), since they are in general the first to arrive, but are deprived of all psychical traits.

2. *Clearness of the term "Suggestion."* Of whatever kinds they may be, all conscious events are "suggestions" when they succeed the perception of the stimulus-word. Their classification and sorting and sifting are all left in the Ausfrage experiment to the experimenter. The observer has only to state all he has experienced in a certain interval of time, and there is no room for ambiguity in the meaning of terms as such. The term "associations," as it is used in the 'instruction' in the common association experiment, is, on the contrary, ambiguous and capable of more than one interpretation. It may mean purely articulatory associations. It may mean "real" associations *i. e.*, those with object-images. It may mean associations between two object-images, as in the case of so-called "association of ideas." Finally, it may mean the mixture of all these, the most natural to occur in real associations. Not only does each observer differ in these varieties of possible interpretations, but also one and the same observer may fluctuate, sometimes voluntarily sometimes involuntarily, from one to the other of these interpretations according to circumstances.[1]

[1]Sometime ago, to see how far the results would differ in the same observers according to the differences of these interpretations, I made tests with several observers, in the first series of which the observers were requested to react under the conditions of the traditional association-experiment. In the second series, they were required to react, if possible, after having some suggested object-images or ideas. The protocols, which were taken by the observers after each reaction, show the result that in the first series

3. *Introspection.* In such complex processes as word-reaction, nothing gives a more direct and trustworthy account than the introspection of the observer himself. Objectively alone (*i. e.* without this essential help of introspection), it is almost impossible even to distinguish an immediate, or articulatory reaction from an intermediate, or object-reaction, not to mention the tracing of the same reaction-words to different sources, or of any further exploitation of associations in general.

4. *Change of Conditions.* The occurrence of a special association or suggestion to the exclusion of others is directly conditioned by the resultants of the three factors: Procedure of experimentation, Kinds of material, and Individual differences. Change of conditions reveals to us the real causes of certain forms of associations, which is not only ignored by, but also will be difficult for, the customary method because of the complication of many other factors such as were mentioned in item 1.

So much for the comparison of the new and the customary method in their application to the study of association. The disadvantages of the latter are clear.

On Association Experiments in Applied Psychology

No one can deny that some important contributions to psychology as well as to practical life have come from association experiments in applied psychology. Their method, however, is not absolutely free from weaknesses, as it is based on the same principles as the preceding.

Its study of individual differences of normal and abnormal mentality consists of two processes: 1, The collection of a number of reaction-words by the customary association method; and 2, the interpretation of the reaction-words. This is undertaken as follows: First, such a logical scheme or classification of associations (according to the conceptual relations of the reaction-words to the stimulus-word) is prepared, as will comprehend all possible forms of reactions under these categories. Then the relative frequency with normal subjects of associations of the different sorts thus classified is taken and serves as a standard with which to compare the frequency with abnormal subjects. Now, regarding some of the interpretations or generalizations attained through

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the reactions consisted of diverse kinds of imagery, with the majority of articulatory associations (purely verbal). In the second series, the majority of the reactions consisted of memory associations. This illustrates how easy it is to get totally different kinds of associations from the same observer by the mere difference in the interpretation of the term "association."

such steps the following remarks may be made. In the generalization that children, imbeciles, idiots, epileptics, etc., react frequently in phrase form, whereas with adults and normal persons this form occurs very seldom if at all, the probable interpretation is that the former do not perhaps understand, or forget, or neglect the requirement for the use of a single reaction-word, whereas the latter observe the rule. This fact of disobedience, etc., itself may sometimes be regarded as a sign of abnormality, etc., but nothing more, because phrase associations are quite natural and frequent under certain conditions, as is shown in our study. In like manner, the generalization that children and imbeciles, etc., react frequently by egocentric associations, whereas normal persons react very seldom, if at all, in this form, cannot be interpreted as an expression of a fair comparison of the actual associations, because a single word by itself seldom furnishes a clue of egocentricity to an onlooking psychologist, unless it is accompanied by a personal pronoun or some other word, that is, unless it is put into a phrase form which a normal person suppresses. This fact perhaps accounts for the exceedingly small number of egocentric or personal associations with normal persons which is reported in these studies. In some cases its frequency goes as low as the ratio of once in two thousand reactions.[1] In fact with passive reactions in our experiment and according to the direct report of the observers, this form, which is merely our memory imagery,[2] occurred in the ratio of once in every two reactions. A large discrepancy indeed!

Reactions by repetition of the stimulus word, which are regarded in association studies, as characterizing the reactions of children and imbeciles, etc., were found as common and natural associations with normal subjects in our experiment, as was just stated. Reactions in the form of explanation or definition, another characteristic of children, imbeciles, etc., were often found in our experiments, especially when the stimulus word was not quite familiar or it was a technical term of the meaning of which the observer was not perfectly sure. So that this tendency to explanatory reaction can hardly be regarded as more than an indication of the degree of acquaintanship with words, *i. e.*, literacy or illiteracy.

To sum up, these so-called characteristic forms in children and the abnormal can all be found in normal adults in their natural associations, *i. e.*, when they react according to natural

[1] Jung und Riklin: Diagnostische Assoziationsstudien. Leipzig, 1906. *Cf.* p. 108.

[2] "Die Einstellung ist eine egozentrische, in sofern das Reizwort vorzüglich subjective Erinnerungen anregt." *Ibid.*, p. 117.

and spontaneous suggestions, as was the case with our experiment, and do not react according to artificial and "sophisticated" associations, *i. e.*, by mere verbal associations, as is the case in the customary experiment with normal observers who are expert enough to obey the "rules."

Remarks on association experiments as a means of diagnosing crimes as well as diseases. The criteria for a so-called significant or critical reaction are: 1, Prolonged reaction time, considered as due to the disturbances of the "emotional complexes"; 2, Apparently unconnected reaction words (having no conceptual connection with stimulus) considered as a "*Deck*" or "evasive" reaction, when the experimenter is unable to account for it, and as a suspicious reaction when he is able to do so. Sometimes a succeeding reaction is examined according to these criteria, on the ground of the phenomenon of "Perseveration." The final or crucial test is furnished by the confession of the (supposed) criminal or patient.

Now, most of our cases of dependent verbal imagery accompanying memory imagery, if they alone were announced by the observer (*i. e.*, memory associations), no matter whether they are emotional or neutral, significant or insignificant, would satisfy the two conditions just mentioned, for they were slower than the simple articulatory associations and lacked, as a rule, *logical or outward connection to stimulus words.*[1]

These criteria are thus helpless in the distinguishing of emotional or significant memory associations from neutral or insignificant memory associations. They are effective only when the observers always react in the form of articulatory or purely verbal associations with insignificant words and in the form of memory associations with significant words. This may naturally occur in laboratory tests, as the observers are trained to articulatory reactions with ordinary words, and are naturally struck by recent memory associations of a few minutes date which, of course, are the strongest and most likely to revive, no matter how insignificant the events were. But

[1]Experiments were made recently by Yerkes and Berry (*Am. J. of Psychol.*, Jan., 1909) and also by Henke and Eddy (*Psy. Rev.*, Nov., 1909) to test the certainty of the diagnostic method in the discovery of certain acts executed by the observers shortly previous to the tests, with the same results in both studies, namely: that the method was certain when it had to do with the determination of two alternatives, even if the observers sometimes tried to "fool" the experimenters. In these cases, it must be remembered, we are not dealing with the two forms of reactions, *emotional* and *neutral*, as is commonly presumed, but, in fact, with only the two forms of reactions, *articulatory* associations and *memory* associations (in these cases, with very recent memory associations), as also is plainly seen in the reading of the tables and introspections in these articles.

such is hardly to be expected in the case of patients and criminals in actual practice, because they may be expected to react very frequently in the form of real or memory associations to ordinary words.

Part III

Analysis of the Simultaneous Concomitants

The foregoing studies have dealt with the conditions of the frequency of images which either preceded or succeeded understanding. In this last part of the study I shall examine the nature of "meaning" as a simultaneous concomitant of understanding, tracing up the following three questions. 1. Whether the concomitants precede or succeed or occur simultaneously with understanding. The preceding and succeeding concomitants may be eliminated from the experience of understanding itself, whatever relations they may have to the latter. 2. Whether or not the simultaneous concomitants are peculiar to understanding or meaning. Those which occur as fully even when there is no understanding may be eliminated from the characteristic constituents of meaning, no matter whether they are constant or not. 3. Whether or not the constituents of meaning can ultimately be reduced to the psychological elements, *i. e.*, pure sensations and feelings. The protocols of the foregoing experiments directly answer the purpose of the first question, *i. e.*, the temporal succession of the concomitants. For the second question an additional experiment was made. The answer to the third question consists mainly of inferences from all the preceding results of introspections. But before entering on the discussion of our results let us take a glance at the main views on the psychology of thought and especially of meaning held by the modern psychologists to whose work we shall have frequent occasion to refer.

§ 1. An Historical Sketch of the Various Views of Thought

1. *Thought as identical with concrete representations (images).* Locke speaks of the possibility of our having pure general ideas free from any particular representations, for instance, of "a triangle which must be neither oblique nor rectangle, neither equilateral, equicrural, nor scalenon, but all and nony of these at once."[1] Berkeley who was quite surprised by this conceptualistic view of Locke, says, "the idea of man that I frame to myself must be either of a white, or a black, or a tawny, a straight, or a crooked, a tall, or a low, or a

[1]Essay, Bk. iv. ch. 7.

middle-sized man."[1] For him meaning, concept or general ideas, as such, have no psychical existence except in concrete representations.

Among modern psychologists James, siding with Locke in opposition to Berkeley, says, "The note so bravely struck by Berkeley could not, however, be well sustained in the face of the fact patent to every human being that we can mean color without meaning any particular color, and stature without meaning any particular height."[2]

Binet in regard to Berkeley's proposition takes, like James, the negative side and refers to two cases as an *experimentum crucis* against it, *i. e.*, cases where we have particular and precise images without having any meaning or thought, and cases where we have thought or meaning without having any particular or precise images. He maintains, also, that '*pensée générale*' can be properly explained by neither conceptualism nor nominalism though probably by "intentionalism" which he himself proposes.[3] Bühler speaks of both being right and wrong, that Berkeley is right in his negation of sensuous representation of a general triangle, and Locke is right in his assertion of the existence of the pure meaning of a triangle without any sensory element, and also that the question of general ideas is totally different from that of abstract ideas or (his) thought or knowledge (*Wissen*).[4]

2. *Thought as identical with the verbal image.* This question first took its definite shape in the controversy between Max Müller on one side and Galton, Romanes and others on the other. The former maintains that all thinking when introspectively viewed is merely inner speech. The latter refer, to cases of chess playing, of the construction of machines in purely visual terms, and also to the framing or searching for the words for an existent thought, a fact quite common to us, as insurmountable difficulties in the way of this proposition.[5]

Identity of abstract thought and verbal image. Taine speaks of his abstract ideas as quite different from a particular representation or even from the "confused and floating representation of particular *araucaria*," alluding to the general ideas of Galton and Huxley.[6] He says, "We think the abstract character of things by means of abstract names which are our abstract ideas, and the formation of our ideas are

[1] Principle, Introduction, 10, 13.
[2] *Ibid.*, Vol. I, p. 470.
[3] Binet A.: L'étude expérimentale de l'intelligence, 1903, p. 151 ff.
[4] *Ibid.*, p. 363-364.
[5] Max Müller: *ibid.*, appendix (1887).
[6] L'intelligence, II, 139.

merely the formation of names which substitute them."[1] Among present authors, Wundt says, "We do not always think in words; we can easily recall actually experienced or dreamed events in mere visual terms. But with abstract ideas, we usually think in words often involuntarily accompanied by the visual image of the words."[2] Decidedly opposing this theory, James says, "The opinion as stoutly professed by many that language is essential to thought seems to have this much of truth in it, that all our inward images tend invincibly to attach themselves to something sensible, so as to gain in corporeity and life. Words serve this purpose, gestures serve it, stones, straws, chalk-marks, any thing will do . . . 'The bricks are alive to tell the tale'."[3] Bühler refers to the fact that the verbal image occurs in thinking only in a sporadic way and is broken and fragmentary without running parallel with thought processes.[4] Ribot discards the theory simply as "inacceptable."[5] The other authors of the school of Würzburg, *e. g.*, Marbe, Orth, Ach, Watt and Messer, seem to agree in the rejection of this theory. On the other hand, recently Dearborn has attributed the utmost importance to verbal images even in the comparison of ink-blots by the eye. He reports that he found in his experiment the presence of verbal images, in cases where the judgments were correct, in all of the numerous observers, except one, who had just a "true feeling" of likeness and unlikeness. This observer was, nevertheless, the most successful of all in the judgments.[6]

3. *Thought as identical with the compounds of the three dimensional feelings.* Wundt calls those "intellectual feelings" which attend complex intellectual processes. "They are in general complex total feelings, into which simple feelings and ideational feelings (*Vorstellungsgefühle*) enter as components."[7] "The feeling of doubt is an oscillating emotional state (*Gemütszustand*)."[8] The "feeling of agreement (which is a kind of *Vorstellungsgefühl*) is introspectively merely a feeling of relaxation with heightened intensity."[9] "The feeling of recognition (*Wiedererkennunsggefühl*) is a

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[1] *Ib.*, I, 1st ed., 254.
[2] Grundzüge der Physiologischen Psychologie, 1902, 5th ed., Vol. III, p. 543.
[3] James, W.: Principles of Psychology, Vol. II, p. 305.
[4] *Ib.*, 317.
[5] "Idées Générales," p. 100.
[6] G. V. N. Dearborn: Experiment on the Judgment of Likeness and Unlikeness of Visual Form, *Journal of Philosophy, Psychology and Scientific Method*, Feb., 1910, p. 60.
[7] *Ib.*, Vol. III, p. 264. [8] *Ib.*, 265. [9] *Ib.*, 510.

subjective symptom belonging not to the ideational processes but to the subjective side of the processes,"—the processes of assimilation of ideas.[1] Its subjective quality "seems a sudden and unhindered change between tension and relaxation, which under circumstances can be joined by other feeling qualities."[2]

Most of the Würzburg authors discredit this Wundtian view of intellectual or cognitive feelings. Orth in his analysis of "*Bewusstseinslage*" (another name proposed by Marbe for intellectual feelings) as introspectively observed by himself and others while serving as observers in Marbe's study on judgment, finds them related to cognition and therefore implicitly to sensation rather than to feeling, and having reference to the object rather than to the subject.[3] Doubt, according to him is, introspectively, thoroughly different from sensations, representations, and feelings proper; and the same with feelings of certainty, contrast, agreement, etc.[4] "What *Bewusstseinslagen* really are," he says in summarizing, "remains to be investigated. So much seems to be certain, that they resisted our analysis and that they are not at all merely another name for the psychical facts that Wundt comprehends under his two new feeling directions, for this contradicts, not only self-observation, but also their great manifoldness."[5]

4. *Thought as judgment and as knowledge is beyond psychical experience.* Marbe in his study on judgment arrived at the conclusion that "there are no psychical conditions of judgment in general that give them the character of judgment as such."[6] And the same with understanding of judgment.[7] Accounting for this, he says, "thus we see very easily that understanding of judgment can never be found in consciousness, because it rests upon knowledge, and knowledge is never given in consciousness."[8] As the processes of judgment are totally beyond consciousness, so in its study there is as little left for psychologists as of physiological chemistry for chemists.[9] Later authors of the Würzburg school agree in criticising Marbe's reflexive theory of judgment as due to too easy stimuli. Bühler simply speaks of his "thought" as actual *Wissen* and not such potential *Wissen* as Marbe means.[10] James speaks of his feeling of tendency (such as feeling of familiarity, recognition, etc.) as not a "psychical zero," but a "psychical fact" though vague and difficult to name.[11]

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[1] *Ib.*, 536.
[2] *Ib.*, 537.
[3] Orth, J.: Gefühl und Bewusstseinslage. Berlin, 1903, p. 73.
[4] *Ib.*, 71. [5] *Ib.*, 128. [6] *Op. cit.*, p. 42, 43. [7] *Ib.*, p. 83. [8] *Ib.*, p.92. [9] *Ib.*, p. 96. [10] *Op. cit.*, p. 361. [11] *Ib.*, Vol. 1, p. 254.

5. *Thought as identical with reproductive tendencies.* Ach calls imageless thought or pure cognition free from any "phenomenological constituents, such as visual, acoustic, kinesthetic sensations or images," "*Bewusstheit.*"[1] He says, "When a word, for instance, 'bell' is presented to me and I apperceive the symbol, I understand what it means. I have the *Bewusstheit* of meaning. According to the theory of *Bewusstheit*, it is not necessary for understanding that one have representations . . . such as auditory or visual images of a bell . . . Each representation which is given in consciousness, for instance, the impression of the stimulus word 'bell,' puts, as is well known, a number of associated representations into the state of readiness. This putting-into-readiness of representations, or excitation of reproductive tendencies, suffices for the conscious experience (representation) of what we call sense or meaning."[2] In criticism of this view, Watt, speaking of meaning as different from the vague, reverberating associations or tendencies, says: "Some maintain that this is a mass of vague associations, word-associations or others, but this is not clear according to the protocol. It rather points to the fact that a concept, such as appear in free self-observation, is something different from vague reverberating associations or a certain number of them."[3] Bühler excluding the mere consciousness of tendencies from his 'thought' or 'meaning,' says: "Thought is nothing vague or half-conscious but something clear, and not a sum but a unity."[4] Titchener speaks of the necessity, in the awareness of meaning, of the co-operation of the both Ach's awareness of reproductive tendencies or 'meaning' and his awareness of relation.[5]

6. *Thought as identical with "fringe"-experiences.* According to James, thought as well as meaning is the feeling of relation which is the felt "glow," "fringe," "echo," or "reverberation" and the transitive experience of mind in distinction to substantive or static experience, *e. g.*, images, sensations, etc. He says, "The meaning of the words which we think we understand as we read, is a sign of direction, . . or, a bare image of logical movement which is a psychic transition, always on the wing, so to speak, and not to be

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[1]Ach, N.: Ueber die Willenstätigkeit und das Denken. Göttingen, 1905. p. 210.

[2]*Ib.*, 216-217.

[3]Watt, J.: Experimentelle Beiträge zur einer Theorie des Denkens, *Archiv f. d. gesamte Psychologie*, 1905 (4), 289 ff., p. 434.

[4]*Ibid*, p. 326.

[5]Titchener, E. B.: Lectures on the Experimental Psychology of the Thought-processes, N. Y., 1909, p. 107.

glimpsed except in flight."[1] Further characterizing meaning as feeling of tendencies, he says, "The sense of our meaning is an entirely peculiar element of thought . . . It is one of those evanescent and transitive facts of mind which introspection cannot turn round upon . . . . It pertains to the fringe of the subjective state, and is a feeling of tendency, whose neural counterpart is undoubtedly a lot of dawning and dying processes too faint and complex to be traced."[2] He further characterizes this feeling of tendency as a tendency of a "nascent image,"[3] as a feeling antecedent to recall, such as a "ringing in the ear," or "dancing in one's mind" of a forgotten name or word, or of the rhythm of a verse, as the feeling of recognition or familiarity which is a "submaximal excitement of wide-spreading association brain-tracts."[4]

Thus we see Ach's conception of 'reproductive tendencies' is quite similar to the "fringe" experiences of James. Ribot's view seems also to approach these conceptions when he considers meaning or concept as an "unconscious substratum, organized and potential knowledge, harmonics which give detonation to the word."[5] Hoernle referring to James, says that James reverses the fact of ordinary experiences where "we notice more of meaning than words. Meaning stands in the foreground and images or ideas or sensory elements in the background of consciousness."[6]

7. *Thought as well as meaning as a "transcending" experience.* According to Messer, sensations and sensation-complexes are perceived merely as contents of consciousness; "they exist or do not exist, but do not point beyond themselves; they do not mean." Thought as also perception, etc., on the contrary, possesses a characteristic attribute of 'transcendence.' "No thought thinks upon itself, *i. e.*, on the constituents of consciousness which we can examine in direct retrospection." "He who, thinks," he continues, "that he could sufficiently characterize thought and perception simply by looking at the existent sensations and images, is like one who believes he could find the value of money by merely examining its material."[7] Further, in regard to the experience of understanding or meaning, he distinguishes two forms attending the reaction to the same stimulus word: 1, general understanding which is further unanalyzable; and 2, more conscious and definite understanding which, he says, sometimes is "not conditioned by the *Aufgabe* [problem or instruction], but is such as would be explained by the predominance

[1] *Ib.*, Vol. I, p. 253.
[2] *Ib.*, Vol. I, p. 472.
[3] *Ib.*, Vol. I, p. 254.
[4] *Ib.*, p. 258.
[5] *Ib.*, p. 132.
[6] *Mind*, Jan., 1907.
[7] *Ib.*, 113.

of the reproductive tendencies in the general constellation."[1] But "the reaction wherein the *Aufgabe* enters and the acts of acceptance and rejection take place, apparently cannot be explained by the mechanism of mere reproduction and association, and herein lies the justification for distinguishing the processes of thought from those of pure associative reproduction."[2]

8. *Thought as a third psychical element.* Bühler, as the result of his study on thought, came to the conclusion that thought-experiences are neither analyzable to sensations nor feelings but so unique and specific that they should be considered as compounds of a third psychical unit or element, *i. e., Gedanke.*[3] Thought, according to him, is act of knowing (*Wissensact*).[4] Meaning, which is a conscious knowing, cannot be represented, but only known.[5] He says that to ask one to explain knowing or thought merely by the terms of the quality and intensity of existent sensations is the same as asking one to explain depth by the terms of height and width.[6]

9. *Thought as indescribable.* All the preceding authors who regard thought as something different from image or feeling proper, agree in finding it as further indescribable. Marbe, in regard to his *Bewusstseinslage* speaks of conscious facts whose contents either totally escape from further characterization or are difficult to approach. Orth says, "Those *Bewusstseinslagen* which were observed by Marbe and by us are of diverse kinds and have only this point in common that they represent psychical facts which could not be further analyzed by us."[7] Ach says, the description of these *Bewusstheiten* by the observers is very difficult because of the difficulty of verbal expression, as they lack "phenomenological representations" (sensations and images, etc.).[8] Watt, toward the end of his study says, "An analytical introspection in this direction is exceedingly difficult . . . We know psychologically as much as nothing about the nature of meaning-consciousnesses which accompany an abstract word."[9] Messer speaks of thought-experiences as further unanalyzable. James speaks repeatedly of the difficulty of description of fringe- experiences; their multitudinous nuances or configurations can be only felt.

10. *Thought, also meaning experiences, as identical with kinesthetic images.* Taking a quite different view from the preceding authors, Titchener, in his recent book on thought-processes, declares that all these authors or their observers who find thought-experiences something different from the

[1] *Ib.*, 82.
[2] *Ib.*, p. 122.
[3] *Ib.*, p. 329.
[4] *Ib.*, p. 361.
[5] *Ib.*, p. 363.
[6] *Ib.*, p. 361.
[7] *Ib.*, p. 70.
[8] *Ib.*, p. 41.
[9] *Ib.*, p. 435.

existent elements, *e. g.*, sensations, images, etc., are victims of stimulus-error; that they do not separate or abstract what they infer from what they actually experience or have, but think them together, just as an observer in color-experiments, instead of reacting to an abstracted red sensation, reacts to the red paper, an object, the result of both sensations and inferences; and that the results of their introspections are mere intimations or indications, and not the descriptions of what they have experienced.[1] Referring to James's feeling of relation, he says "the phrase 'feeling of relation' is no more unequivocal, as a psychological term, than the phrase 'idea of object' or 'consciousness of meaning.' It carries an intimation, an indication, a statement-about; it does not describe. And the question for psychology is precisely that: what we experience when we have a feeling of relation?"[2] The consciousnesses of thought when described are merely kinesthetic images or sensations. All other consciousnesses are not the direct data of introspection but the results of addition by reflection and inference.[3] "And all such 'feelings,' he says, —feelings of *if*, and *why*, and *nevertheless*, and *therefore*, normally take the form, in my experience, of motor empathy. I act the feeling out, though as a rule in imaginal and not in sensational terms."[4] Regarding the distinction between kinesthetic images and sensations, he says, "Actual movement always brings into play more muscles than are necessary, while ideal movement is confined to the precise group of muscles concerned." "The sensed or actual nod (that signifies assent to an argument, and frown (that signifies perplexity) are coarse and rough in outlines; the imagined or mental nod and frown are clean and delicately traced."[5] He wonders why James does not take the same introspective view of his 'feeling of relation' as he does with the feeling of a 'central active self' in which he (James) finds nothing but 'bodily processes for the most part taking place within the head.'[6]

§2. CONTENTS OF MEANING WITH FAMILIAR STIMULI

What are the actual contents of consciousness at the instant of understanding, the direct psychical experiences which constitute the experience of understanding familiar and easy words or phrases? The protocols of all the foregoing experiments show that there was not one kind of such content only but several. Arranged according to the general order of succession or quickness, they were: 1, Feeling of familiarity or recogni-

[1] *Ib.*, p. 145.
[2] *Ib.*, p. 185.
[3] *Ib.*, p. 185.
[4] *Ib.*, p. 186, 187.
[5] *Ib.*, p. 20-22.
[6] *Ib.*, p. 30.

tion of the stimulus; 2, Feeling of concept; 3, Feeling of content; 4, Feeling of direction; 5 Half-developed or indefinite images; and lastly 6, Fully developed or definite images.

1. *Pure Feeling of Familiarity.* With a very familiar word or phrase, or in repeated reaction to a stimulus previously understood, the occurrence of just the feeling of familiarity alone or the recognition of the stimulus as the one understood before, was sufficient to release the reaction or cause the stimulus to be felt as understood.

For instance: *Mountain.* (Obs. *Sn.* III—ii, Time—0.9″.) "I read it in inner speech and reacted as the word seemed familiar to me, *i. e.*, when the feeling of familiarity came. I didn't get any further meaning. No imagery, no associations until after I reacted."

Psychology. (Obs. *Ch.* III—iii—15, Time—0.5″.) "The first feeling of recognition of the form of the word was followed instantly by the feeling of familiarity. There was no imagery. In this particular case it appears that the feeling of recognition and the feeling of familiarity are the same thing. There wasn't any imagery, any attempt to define. I recognized the word. Absolute certainty as to understanding."

This type of meaning was quite common and frequent with all observers and regardless of the concreteness or abstractness of the stimulus word. It was the first and quickest to occur of all the types of meaning. It seldom occurred, however, with the mere visual perception of the stimulus word or phrase. Audito-motor reading of the stimulus was necessary to release the reaction even in this type. In active reactions and with familiar abstract stimuli, it was seldom followed by any suggested images in any observers. In active reactions with familiar concrete stimuli, it was sometimes followed, especially with observers of concrete (or visual) type, by suggested images which, however, always occurred after the reaction. And such was the case with all the passive reactions where the suggested images made the terminus of the reaction occurring long after the entrance of the feeling of familiarity or recognition.

2. *Pure feeling of Concept or Meaning.* In the preceding case both sensory and conceptual familiarity or recognition fused so closely together that there is difficulty of analysis, though sensory familiarity evidently predominates in such reflexive reactions. With less familiar stimuli, or when the observers waited longer with very familiar stimuli, these two generally became separated and occurred in succession, the sensory recognition always preceding the conceptual.

Example: *Pomology.* (Obs. *Ac.* II, w—10.) "Recognized the word and thought it familiar, but on closer examination, I found that I could not understand its meaning."

Heaven, (Obs. *Cf.* II, w–5.) Did not apperceive the word for a minute. I was not quite attentive. Then I got a purely verbal meaning of it without imagery. By verbal meaning I mean I first recognized it. Then I

had a slight feeling. It was not at all a sort of tridimensional feeling, but an idea of something sacred. But I call it a feeling because it was not definite."

In its frequency and conditions of occurrence, this type of meaning was practically the same as the preceding one except that the latter always preceded the former in case of concurrence.

3. *Pure Feeling of Content.* To this belong the experiences which the observers expressed as "full of meaning," or "content," having "rich associations," or "coming associations," etc., which were accompanied by no particular images or associations. The chief marks were the richness and poorness of content. A feeling of rich content was generally found with stimuli designating topics which observers were interested in or familiar with, and a feeling of poor content with the stimuli indicating uninteresting or unfamiliar subjects.

Example: *Peace.* (Obs. *Sn.* III,—iii—5. Time—1.0".) "I read it in inner speech. But the inner speech was not very clear this time. And I think, I had a feeling of the meaning of the word. Whether it was different from the feeling of familiarity I am not sure. But it seems to have been something more than a mere feeling of familiarity. This something may be some feeling of moving toward something, or of some possibility of development and is very hard to describe."

House. (Obs. *Cff.* I, w—3.) "Perception of my voice [inner speech]. Then came the feeling of familiarity. That feeling seems to me to be composed of various kinds of images not yet actual. I would call it almost composite. If I should think about it longer I would have some particular images out of it."

4. *Feeling of Direction.* This feeling is the experience of the mind's pointing to or turning in the direction of the place where a particular object or event referred to by the stimulus was experienced. It is an incipient form of object imagery.

Pedagogy. (Obs. *Sn.* III—i—14.) "I read the word in inner speech but not very loud and was not quite sure whether I read it correctly. So I read it again and had a faint feeling that I knew the word. Then I thought of the direction of the Dr. B's room and probably also had a very vague suggestion of Dr. B himself. The consciousness of direction was very clear. I had the word 'teaching,' probably in inner speech."

Example: *Head.* (Obs. *Cff.* I.) "Always an after effect of sound. I listened for the after effect before the recognition of the meaning. Then came the feeling of familiarity followed by a vague idea, almost a feeling of location of upward, top of human head, idea of something above. I had no definite image."

This experience occurred frequently, especially among observers belonging to a rather non-visual type. In passive reactions, and especially with observers belonging rather to the visual or concrete type this experience was, in general, replaced by rather fully-developed object images.

5. *Half-developed Images.* These were faint and vague representations of objects or circumstances, which, on account

of faintness or indefiniteness of imagery, were sometimes termed by the observers "ideas," something "thought of," etc. This was especially the case with a quick recapitulation of many particular past experiences.

Example: *Memory*, (Obs. *L. M.* III—i, 4.) "First a visual impression of the word. Then reading in inner speech. And then I had a bird's-eye view of all that I have been working at for several weeks; I have that subject. Some pleasure and satisfaction in seeing the word. This word was very full of meaning, but there were no particular visual images. Its meaning could not be expressed in so short a time."

Philosophy. (Obs. *Ac.* II, w—65.) "I thought of Plato, Aristotle, Kant and Hegel in connection with their productions. No definite visual or auditory elements.

6. *Fully-developed Images*. These are suggested object-images as well as verbal images such as have already been described (Part II, above). They were in general the slowest to occur. They were generally found in passive (or prolonged) reactions and seldom in active (or quick) reactions to familiar stimuli. In case of concurrence with the preceding experiences, they were the last to occur, that is, they made the terminus of the reaction.

Conclusions

1. These results negate the theory of the identity of thought with concrete representations and also the theory of the identity of thought with verbal images so far as meaning experiences are concerned, as these images are a part only of our fully-developed images,—one of the six types of meaning.

2. A chief condition determining whether or not one shall have a definite image (visual or verbal or other), in understanding familiar words or phrases, is the length of time the process continues. If one reacts quickly, *i. e.*, at the stage of familiarity, or concept, etc., one will not have, as a rule, any definite images, regardless of individual differences, and of the concreteness or abstractness of the stimulus. If one dwells longer upon the stimulus one will usually have some particular representations, the majority of which will be recent memorial associations, in predominantly visual form, in the case of visualizers, and in predominantly verbal form in the case of verbalists, regardless of the concreteness or abstractness of the stimulus.

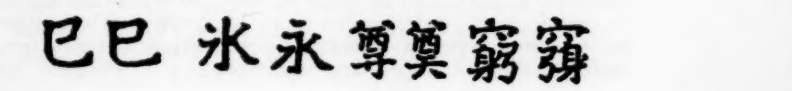
Remark: Ach suggests that pure meaning appears most prominently in the quick reading of a text (*op. cit.*, p. 261). James speaks of the two kinds of meaning, *i. e.*, dynamic meaning which attends the understanding of a phrase and is "usually reduced to the bare fringe," and static meaning which attends the understanding of an isolated word and is usually accompanied by object-images when the word is concrete and by nothing except word-images when it is abstract." (*op. cit.*, p. 265). Wundt says, "Whether the complication of these elements, ideas, word-sound and word-

script, occurs completely in our consciousness depends besides on which of these elements acts upon us directly in sense perception. The ideas can stay isolated under certain circumstances. The word-sound generally calls forth the object-image. The word-script awakens the word-sound with the object-image." (*Op. cit.*, vol. III, p, 543.) John Mill commenting upon Locke and Berkeley's difference of opinion, says, "While the concentration of attention lasts, if it is sufficiently intense, we may be temporarily unconscious of any of the other attributes, and may really for a brief interval have nothing present to our mind but the attributes constituent of the concepts " (Examination of Hamilton, p. 393). This last view seems to come the nearest to the above result of ours if we change the indefinite expression "intense" in the quotation into "brief".

§3. SELECTIVE EXPERIENCES WITH UNFAMILIAR STIMULI

In the understanding of unfamiliar stimuli where the meaning did not come promptly there appeared in consciousness a new group of experiences in the form of judgments, *i. e.*, of approval or rejection of the contents or suggestions as right or wrong. They were experiences or consciousnesses of searching, waiting, selection, rejection, certainty, uncertainty, hesitation, etc., generally attended by feelings of tension and relaxation. These are sometimes regarded as characteristic constituents of meaning. A special test was therefore made in connection with the third experiment to determine how far these experiences are alike and how far they are different in different types of thinking, *i. e.*, in the understanding of phrases and words and in the identification of non-sense stimuli.

Procedure. In the third experiment, beside English words and phrases, a number of Chinese characters, as a kind of nonsense stimulus, were added. With these characters, instead of understanding, the process was one of identification. The five English speaking observers were requested to compare the second of the two stimuli with the first, or standard, and to tell whether the two were identical or different. The standard was exposed for one second and immediately afterward the comparison stimulus which was sometimes identical and sometimes not identical, but always quite similar in shape to the standard. The reactions, all active, were made by pressing an electric key. Introspections were taken in the same way as with understanding-reactions. Easy and difficult stimuli were made by different combinations of complexity and irregularity in the shapes and in the degree of resemblance between the standard and comparison stimulus. For instance the following are some of the pairs thus matched, having shapes apparently similar but not identical.



These identification-reactions and the two forms of understanding-reactions, *i. e.*, of words and of phrases, were arranged in such a way that a difficult reaction of one form was followed by a difficult reaction of the other form; and the same with easy reactions. The observers were requested, after giving the introspections of each reaction, to report, in addition, what processes (or experiences) in the two successive reactions they found similar in their abstracted forms and what different.

The following is a sample of such protocols:

A. Comparison of Difficult Reactions

Understanding. Nostrum, (Obs. *Ch.* III—iii, 2, time—2.0″). "Feeling of having seen the word came first. I read the word through once. First suggestion was that of the Latin word. And there I got the meaning of the word but not quite certainly. A little bit of feeling of tension is staying. I was n't quite sure of the content. I interpreted it as a sort of fake medicine."

Identification. 戀 (Obs. *Ch.*, time—) "Not sure. What I tried to do was to look at the separation of the figure rather than to judge by general impression, and found that some are the same while others are doubtful. So that the feeling is one of uncertainty, doubt in this case. Also there was a feeling of strain, tension with unpleasant coloration."

Comparison of the experiences. "The feeling of searching for something, of groping is quite similar with the cases of hard English words. And also the feeling of strain, tension with unpleasant coloration, is just the same."

B. Comparison of Easy Reactions

Identification. 我 (Obs. *Ch.* time, 1.0″) "Different. The impression came from the general form and not from any one particular line. Feeling of certainty is rather complete. At first there was a feeling of strain and tension which dropped as soon as I reacted. The experiment ended with a little pleasure, because I recognized the difference. So this was a personal feeling attached to the consciousness of success."

Understanding. Peace. (Obs, *Ch.* time—1.0″) "I read it and recognized it at once. No feeling of tension. There was slight visual imagery. Feeling of certainty as to the meaning of the word. In this feeling of certainty there was the feeling that rich associations could be started."

Comparison of the experiences. "The feeling of certainty with the Chinese characters lacks the feeling of rich content. In the Chinese characters there is a feeling of recognition in the strict sense, while in the English there is no revival of the occasion when I first saw it. Thus the recognition of the Chinese character is much more a matter of sensory form than of content."

Results of the Comparison

A. *Feeling of tension and relaxation.* In regard to the qualitative differences of these feelings, all observers agreed in finding them very similar or even identical in character in the three types of thinking: identification of characters, understanding of words, and understanding of phrases. In

regard to the quantitative differences, they found, as a rule, more tension in difficult understanding than in difficult identification, and in difficult understanding of phrases than in that of words.[1]

B. *Feeling of content.* All observers agreed in finding decidedly richer content feelings with words and phrases in general and very poor content feeling or none at all with the characters.[2] In words and phrases, they found words frequently to have richer content than phrases. The content feeling differed according to the particular words and phrases.

C. *Feelings of certainty and uncertainty, i. e.,* of understanding and of judgment. Three observers found these feelings quite similar or identical in the three types of thinking, whereas the other two observers found them rather different, not only among the three types of thinking, but also from stimulus to stimulus in each type of thinking.

It appears that the other two observers, instead of comparing these feelings in their pure and abstracted forms, compared them in their complex and concrete forms. This is plainly seen from the fact that in accounting for the differences they referred either to the differences in content feelings or to those in associations or images. For instance:

Obs. *Ch.* (III—iv, 2.) Comparison—"As to the feeling of certainty this experience [Chinese character] is very much less complex. It simply consists in the recognition of the visual image and practically no associations at all."

Obs. *Sn.* (III—iii, 13—14.) Comparison—"This feeling of certainty [with the Chinese character] in my mind is connected with the seeing very clearly the whole space where I expected to see a black spot. The certainty in the case of the word is connected with the feeling of easy association. In this case it is only a feeling of difference."

The following is a typical case of the comparison of these feelings in their abstracted form, which was the method of the other three observers.

Obs. *L. M.* (III—iii, 3.) "There was no meaning except the visual impression. When my eye traversed the second figure and came to the place where it differs I felt that there was something wrong. And then I called up the visual image of the first one and recognized the difference, with a feeling of certainty. This feeling *itself* is just the same as in the cases of the recognition of English words."

The author thus believes this discrepancy is merely an

[1] The maximum effort or tension was experienced not with absolutely difficult or unfamiliar stimuli but with partially unfamiliar ones. With totally difficult stimuli, observers abandoned the attempt as hopeless or too complex and therefore promptly relaxed.

[2] When the reproduction of the standard was faint or merely felt, it was sometimes regarded as having a very poor content; when the reproduction was more or less distinct it was regarded as having no content, but simply as an image.

apparent one arising out of the differences in the ways of abstracting the phenomenon to be observed.[1]

So much for the experiences compared by all observers. The other similar experiences, which were compared by some observers and viewed as similar, or practically the same, in their abstracted forms, were feelings of searching, groping, waiting and the peculiar, though frequent, experience of the sudden appearance of images or ideas, feelings of satisfaction, dissatisfaction, etc. These results point to the following conclusions: 1. Selective experiences, as also feelings of tension and relaxation, cannot be regarded as either the sole or the characteristic constituents of the meaning of words or phrases, for they were found as well in reactions to nonsense stimuli. 2. On the other hand, as the *feeling of content* was found to be not merely different but totally lacking in the reactions to meaningless stimuli, this feeling may with great probability be regarded as one of the characteristic constituents of the meaning of words and phrases.

§4. ULTIMATE CONSTITUENTS OF MEANING

What are the ultimate psychical constituents of the six types of meaning mentioned above, *i. e.*, can they be reduced to psychological "elements," to three dimensional feeling and sensation having two attributes, quality and intensity, or to a specific image or feeling? This point the observers were not asked to decide. But from the results of all the foregoing study, the writer may make certain inferences. Let us start at the last type of meaning.

(1.) Fully Developed Images. Of these, visual images of objects, verbal images (in audito-motor or visual terms), suggested organic (as well as kinesthetic) images are so clear in their ultimate constituents as to need no comment here. The constituents of memory images were complex and their dominant factors, moreover, varied according to individual observers and circumstances; but, it seems, a visual factor, though sometimes faint and incipient, was a constant one, for a memory image has always a spatial localization, *i. e.*, reproduces the place where the object or event was experienced. The same thing may be said about the constituents of the

[1] It is interesting to note that Rousmaniere had the same result in a similiar experiment. The report says in part: "The subjects did not agree in their answers to the first problem. Some found not only that the certainty connected with their belief in the results of their addition seemed to be of a distinct type from that connected immediately with the sense of sight itself . . . . Others found but one kind of a feeling of certainty." (Harvard Psychol. Studies, Vol. II, p. 279.)

"indicative images" which are the representation of, or a pointing to, the concrete objects near at hand.

(2.) Half-developed Images. Their constituents, in the main, seem to be the same as those of fully developed images, except that in the former they are faint and incipient.

(3.) Feeling of Direction. This made an incipient stage of object-images having particular localizations, *i. e.*, memory images and indicative images. Consequently a visual factor in its faint and incipient form seems to be a constant factor. In the case of some observers the feeling was sometimes experienced predominantly in kinesthetic terms.

For instance: *Duty before pleasure.* (Obs. *Sn.* III—ii—15.) "I expected a sentence. I read it in inner speech and had the familiarity-feeling for it and at about the same time, perhaps a little bit later, I had that sort of classification which I frequently have in such cases, and thought this is a moral maxim. Then I tried to get more special cases of some duty which I have. I tried to think, as an example of this, of something connected with my own affairs, but I did n't succeed very well. I had a very vague and indefinite idea of 'duty' and 'pleasure' and there was a kind of location here in the direction of my office. I did n't get any further idea about it, except the thought about something I had planned. But I think it may be this that I had some letters this morning which I wished to read, and was thinking that I would not be able to read them until after my lecture. There was only a tendency to run in that direction without any actualization of the circumstance."

Victory or Westminster Abbey. (Obs. *Cff.* I, A—14.) "Feeling of surprise because I expected something more, and also because of the peculiar construction of the sentence. The name Nelson came up almost at once, partly because his ship was called 'Victory' and partly because it suggested a saying such as he might have uttered. A vague almost visual image of the picture of Westminster Abbey and feeling of direction, *i. e.*, from the sea where the battle was fought to London as if my eyes were moving from one point to another—I felt inner movements of the eyes. Feeling of meaning was of a great warrior determined either to win or die. In this case there was n't much inner speech. The visual image took the place of the auditory though it was not very definite."

Sometimes the description of this feeling was too indefinite to surmise.

For instance: *Rhapsody.* (Obs. *Sn.* III—i—17.) "First my attention was good. I read the word in inner speech, and I had a suggestion of it in a musical sense, a certain piece of music called a rhapsody. I think there was a sort of direction toward Mechanics Hall where the concert was held. Two or three years, or it may be one year ago, I heard the Hungarian Rhapsody there. There was a sort of vague association with other concerts. Then I read the word again in inner speech and then I tried to get a meaning for it and that time a very faint, shadowy suggestion of a person in a state of rhapsody was seen. The direction of it was different from that to Mechanics Hall. It was very indefinite and faint and hardly can be called an image at all.

Heaven. (Obs. *Gl.* I—w—15.) First sound, next understanding. And third, a vague image of the sky or rather opening above. The mind went upwards. No visual image of the color.

(4.) Feeling of Content. The observers often described

this feeling as one of coming associations, incipient suggestions, etc., as already mentioned. This introspection is corroborated by the following considerations in regard to the relation of the feelings of richness and poorness of content to their concomitant conditions, *i. e.*, 1, to the material or kind of stimulus; 2, to the duration of the reaction; and 3, to the conditions under which the stimulus was given.

a. Material conditions. With absolutely difficult or unfamiliar stimuli when the observers had no definite suggestions or associations and their minds were "shut up" or "blank," no content feeling was present. Uninteresting or unfamiliar words usually awoke poorer content feeling than interesting or familiar ones did. Chinese characters (the ones to be compared in the identification experiments) awoke no proper content feeling. With a single definite and vivid general object-image (no matter whether it was visual, organic or kinesthetic), excepting memory images, the observers seldom experienced a rich content feeling, excepting in some cases of passive reaction where the observers exceptionally dwelt long on the suggested images.

b. Duration of reaction. Content feeling was not present in the reflexive type of reaction released by the pure feeling of familiarity or recognition alone. It was replaced or weakened on some occasions by a definite or vivid image occurring later in the development, which shows that proper time relations are essential for the appearance of this feeling.

c. Conditions under which the stimulus was given. Familiar words or phrases presented simultaneously in number and for a short interval awoke no content feeling.[1] Isolated words as a rule awoke richer content feeling than those given in phrases. A single noun awoke frequently a richer content feeling than did a short phrase.

These phenomena of the concomitances of the subjective and objective changes will be difficult to account for adequately in any other way than to assume a content feeling as a consciousness of the actual, simultaneous, and incipient excitation of a number of past experiences or images related to the stimulus. If a large number of such associations is actually excited, the result will be the feeling of richness of content. If the number is small, the result will be the feeling of poorness of content. If there is no association, the result will be the feeling of no content. The lack or poorness of content feeling in the case of sensory familiarity, "pure concept," and a number of simultaneously exposed words and phrases, is simply due to the insufficiency of necessary time

[1] This test was made in one of the auxiliary experiments.

for the actual reinstatement of past experiences, even in an incipient way. Familiar words or phrases have, of course, numerous potential associations, but to have a content feeling it is necessary to actualize some of them, at least. Too vivid or too definite single images work detrimentally to the feeling of rich content, because they absorb too much of the mental energy to awake at the same time numerous other incipient reproductions. Isolated words give richer feeling than phrases under the same circumstances, because there the associations are not circumscribed and the mind can welcome whatever related associations may revive, and the result is the crowding together of these associations in their incipient forms which is felt as richness of content. But this state of experience does not long endure, for one of the strongest of them, such as a recent memory association, will soon push itself up completely, as was often the case in our experiments. When a word is interwoven in a context, only such associations are tolerated by the mind as will conform to the general purport or meaning of the phrase, and all other incoherent associations are suppressed.[1] The richer feeling often attending a single word in comparison with a short phrase is perhaps due also to insufficiency in the time allotted to each word of the phrase for the development of its own content feeling, *i. e.*, the mind moves on too quickly to the next word. The rich content feeling of a memorial association, in spite sometimes of its comparative vividness and definiteness, is very likely due partly to the details and variety of the imagery and partly to emotional excitations. The following instances will illustrate this point.

Philosophy. (Obs. *L. M.* III, ii—2.) "Sense came very quickly; not with the reading of the word but immediately after; and it seemed to have a great deal of meaning, perhaps because of the fact that I had been reading philosophy last night. There was feeling of tension and excitation until I got the sense. The feeling was agreeable."

Sleep is necessary for health. (Obs. *Ch.* III—ii—9.)..."The feeling of familiarity was pretty complete because it suggested my own condition, that is, I did not sleep last night very well. So there was a pleasure in it, and thus the feeling of familiarity had a rich content, for it refers to personal interest."

Sleep is necessary for health. (Obs. *E. M.*) "Perfect feeling of familiarity and certainty of judgment. It awoke a good deal of association with it, because I have made an effort without success to sleep after dinner this afternoon.

Regarding the ultimate analysis of this feeling which is the awareness of numerous simultaneously excited incipient

[1] *Cf.* Huey's result: "The words given in isolation gave a greater variety of association than did the context words." *Am. J. of Psychol.*, Vol. XII, p. 282 ff.

images, it is clear that this feeling has nothing to do with the tri-dimensional feelings which may, or may not accompany it by way of addition. Again, as it is the direct awareness of images themselves, it cannot be called a subjective affection or emotion, excepting in cases of emotional excitations in memorial association which give the meaning a "sense of reality" or "warmth." Emotions in these cases, however, only emphasize and do not make up the content itself, which is constituted of memorial associations. There is need always of incipient images for meaning, whether it is cool or warm, dry or rich. Whereas, emotions of various form can exist without understanding or sense of meaning.

Neither can we describe the content feeling in terms of a definite and specific image for it is, first, the resultant of many images or associations, each of which consists of more than one specific or sensory image (such as a visual, an auditory, a motor, etc.); and, secondly, these images are all only incipiently awakened. The pure feeling of richness or poorness of content, without any subjective trace of images, may be, in the meanwhile, called a "total feeling," not in the sense of the fusion of feelings proper, but in the sense of the fusion of faintly excited different images.

(5.) Pure Feeling of Concept or Meaning. Owing to the vagueness of the customary terms "concept" or "meaning" as regards their psychical constituents, the writer has no direct basis for analysis when the observers simply speak of a concept or meaning without further description. So that so long as there is given no positive description of this experience, the only way at hand is to infer it. The inference is made from the nature of other types of meaning which generally immediately precede or succeed the feeling of concept, or sometimes replace it. The type which precedes is the pure feeling of familiarity, or recognition of the stimulus as the one already familiar. The type which succeeds is the pure feeling of content. So that a pure feeling of concept, meaning or knowing, without any further configuration or content may be identified with the pure feeling of recognition or familiarity, or with something quite similar in nature. If the feeling of concept or meaning has something more substantial, it may be identified with the content feeling. If its nature becomes more materialized, so to speak, it will be found identical with the feeling of direction, or with half or fully developed images. But in such cases it is no more pure.

(6.) Pure Feeling of Familiarity or Recognition. This feeling, as already stated, was the first and quickest to appear of all types of meaning, and attached directly to the stimulus with-

out any intermediary except audito-motor reading when the stimulus was exposed. It thus makes the first or the most primitive stage of the series of reproductive processes. As a reproductive process, there seems to be no important differences between the experience (as such) of familiarity with the stimulus as one experienced before (whether understood or not) or "sensory recognition," and the familiarity with the stimulus as one understood before or known, or "conceptual recognition."[1]

In the earlier stage of this feeling there was often no subjective difference between the "sensory familiarity," *i. e.*, the recognition of the stimulus as one experienced before (whether understood or not), and the "conceptual familiarity," *i. e.*, the recognition of the stimulus as one, the meaning of which is known to the observer. This fact is shown in the cases of premature or mistaken reaction, as mentioned before. Thus in their first stage of reproduction both sensory and conceptual familiarity must be very much alike or identical.[2] The subjective criterion by which the observers became soon after aware of their mistakes must very likely be the presence and absence of content feeling or "coming associations."

So much for the psychological nature of pure knowing as meaning; now regarding the ultimate constituents of sensory familiarity. Let us take the simplest case. Perhaps the simplest, purest and at the same time the most durable type of this feeling is that which was experienced by the observers in the recognition of the Chinese characters in the forms of purely visual nonsense stimuli practically free from associations. Though obviously this feeling is thoroughly originated by the previous impression of the same stimulus, the observers found it difficult to give any positive description of it in terms of psychical elements. By way of negative description, it may be noted that not only was there no one of our observers who ever positively identified this experience with tridimensional feeling but also there were many who reported it as decidedly different. That this feeling is not a mere alternation of the feelings of tension and relaxation is seen in the fact that observers often relaxed (thinking the characters too complex to identify and so giving up the attempt) without

[1] The reader should not confuse this case of the reproduction of the feeling of knowing of once known (or easy) stimuli with the processes of knowing for the first time of unfamiliar stimuli.

[2] It must be remembered that we are dealing here with the reproduction of the feeling of knowing awakened by the perception of once known or understood, *i. e.*, familiar or easy stimuli, and not with the processes of knowing for the first time of unfamiliar or difficult stimuli which are quite complex.

having the experience of familiarity or recognition. Nor can it be regarded as a specific image, for it occurred earlier than any definite image. Even organic imagery or sensation which is more primitive and undifferentiated and consequently more all-embracing than kinesthetic imagery, will no more cover this feeling than do feelings of tension and relaxation. One will, perhaps, find this feeling in its bare form to be localized centrally rather than peripherally, as "spiritual" rather than corporeal. I may say, therefore, that this feeling is a fundamental, not further reducible, retrospective quality of a present impression, *i. e.*, a coloration or configuration given to the present impression by the rudimentary revival of its past experience. The present impression may be any existing content, sensation, feeling, image, idea, thought, etc. It is thus different from ordinary quality or intensity of sensations. It is not an independent element, as it attaches always to sensations or feelings and never occurs alone. The pure feeling of knowing awakened by familiar stimuli is only a special case of this feeling of familiarity; consequently "thought" in such a sense is neither a third element[1] nor a highly elevated something, but merely the most primitive and rudimentary form of reproduction. Thought in the sense of "transcendental" reference[2] which seems to have more content than pure recognition or knowing, may be found in our content feeling if its introspective aspect is indefinite, or in the feeling of direction or the indicative images if it is more definite. Bühler's "intention"[3] in the sense of condensed thought or quick recapitulation may be found in our complex memorial associations as half-developed images. In short all varieties of meaning-experiences are found as belonging to one or other of the different stages of the revival of the related past experiences.

Social and practical custom attaches a certain cluster of associations to a word or phrase as its meaning to the exclusion of others, so that our understanding of a word or phrase, which is a direct or indirect,[4] incipient or full recalling of such related associations, is, in all cases, a selective or purposive action from the logical or outer point of view. With easy or familiar words such selected associations are, however, ever ready and come promptly without any subjective or psychological experiences of the sort which usually characterize the selective processes, so that psychologically, or from

[1] *Cf.* Bühler: *Op. cit.*, p. 329.
[2] Messer: *Op. cit.*, 113.
[3] *Op. cit.*, p. 346 ff.
[4] That is, through the associations of intermediary images whose meanings are well known.

the inner point of view, a cluster of selected associations or meaning once mechanized becomes identical with a cluster of random associations, or pure reproductions. What is then the meaning in case of an unfamiliar or difficult word or phrase the comprehension of which is attended by a series of selective experiences, such as, feelings of effort, suspense, hesitation, searching, rejection, doubt, uncertainty, etc.? The answer is that a meaning, as a *resultant*, remains always the same whether it is reached through a strenuous or an easy process, whether it is consciously selected or mechanically reproduced. These selective experiences were not only common in all types of active or volitional thinking, whether it is understanding of abstract phrases or comparison of sense impressions, but are also found in their pure forms to be very much alike or identical. They were found to be stereotyped and did not develop to such successive series as did the reproductive tendencies, excepting that they showed changes in intensity and oppositions like those of feeling proper. Their apparent configurations and development must be, in reality, those of the content or reproductive series to which they attach. Clearness and unclearness of meaning, abstracted from content-feeling or reproduction, may be reduced to the mere feelings of certainty and uncertainty.

Further inquiry into the ultimate constituents of feelings of certainty and uncertainty and other selective experiences, which can be found in simpler and purer forms in the identification or comparison of purely sensory stimuli, is left for later studies.

Summary of the Principal Results of the Study

1. Whether we have audito-motor or visual imagery of the stimulus word depends primarily upon whether the word is exposed or spoken.

2. The kinds of imagery, the frequency of which seemed markedly influenced by the individual peculiarities of the observers, were as follows: 1, Motor speech; 2, visual speech; 3, associated (suggested) word-images; 4, associated object-images in visual terms.

3. The frequency of memory images is primarily conditioned neither by the concreteness or abstractness of the stimulus word nor by individual peculiarities, but by the slowness or quickness of the reaction.

4. The customary method of association experiments seems to be too artificial for the study of natural or real associations. Whereas the *Ausfrage* method seems to be better adapted both to the study of the general laws of association and to the study of individual peculiarities of association.

5. Whether or not one has in the understanding of a word or phrase a concrete representation depends primarily upon the duration, *i. e.*, upon the time one dwells upon it.

6. The characteristic constituents of the meaning of a word or phrase are not selective experiences, but series of different phases of reproduction.

7. "Feeling of concept" may be reduced to either "feeling of familiarity" or "feeling of content." "Feeling of content," which is the awareness of the more or less fused aggregate of incipient associations, seems to be hardly reducible to any specific images. "Feeling of familiarity," which is the most fundamental and elementary form of the reproductive experience and seems to be reducible neither to the feelings proper nor to the so-called intensity-quality attributes of sensations, may be regarded for the present as a third or retrospective quality of sensations or other psychic experiences.[1]

[1] I wish here heartily to thank Dr. R. Acher, Mr. C. Ankeney, Dr. H. W. Chase, Dr. E. W. Coffin, Dr. C. Guillet, Mr. G. Hirose, Mr. S. Kanda, Mr. M. A. Kaylor, Dr. T. Misawa, Dr. E. Mumford, Mrs. L. Mumford, Dr. C. A. Osborne, Dr. E. C. Sanford, Dr. T. L. Smith, and Dr. G. H. Steves for their kind services as observers. I desire especially to acknowledge my great obligation to Dr. E. C. Sanford for his kind assistance in many ways essential to the completion of this paper.

THE PSYCHOPATHOLOGY OF APRAXIA

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It is only under special and favorable circumstances, either of experiment or of disease, that certain complex psychic or motor disturbances can be traced to an exact cerebral localization. The most interesting and at the same time the most complicated of these disturbances seem to be localized in some portion of the left hemisphere, particularly those conditions in which there seems to be a loss of the various types of speech images (aphasia) or a loss of the motor memories of the limb movements for a definite act or purpose (motor apraxia). According to recent researches, the left hemisphere seems to preponderate, in certain requested or spontaneous movements of the limbs in the same manner that it preponderates in speech. For instance in many lesions of the left hemisphere in which the right arm and leg are paralyzed, there may result a motor apraxia of the non-paralyzed left arm, thus indicating the existence of a special action of the motor centres of the left side of the brain. It seems likely that these various complex phenomena are really disorders of associative memory, either for identification or motility. There are not only different types of these disturbances but also different varieties of the same type, from the simplest to the most complex.

It is the purpose of this paper to review the recent literature on apraxia, to attempt to determine what light these studies throw upon a complicated psychic disturbance which seems to have a fairly definite cerebral localization and finally to study two cases of apraxia which have come under personal observation. The harmonizing of certain anatomical data with mental disturbances is of the greatest psychological importance, and nowhere can this be better done than in the problem of apraxia.

Apraxia was a term formerly applied to the intellectual non-recognition of objects, but the more recent investigations have shown that the term had best be limited to certain essential disorders of voluntary acts and movements. The chief disturbance in motor apraxia is an inability to make movements for the purpose demanded by the will, although the subject may understand commands and the use of objects; memory and attention may be normal and the limbs may be free from

paralysis, ataxia or tremor. Liepmann's case of unilateral apraxia which was studied clinically and anatomically in a most thorough manner, has formed the basis of the modern conceptions of the condition. In this case there was successful correlation of the clinical symptom-complex with the pathological findings. Later Liepmann extended his studies to comprise all the motor disturbances of brain disease.[1]

Previous to the work of Liepmann the ideas concerning the nature of apraxia were in a very unsatisfactory condition. It was looked upon as a form of a disorder of identification related to mind blindness. Hughlings Jackson's ideas concerning imperception or Allen Starr's description of the loss of object memories, are instances of the older interpretations. Monakow had also observed that certain aphasics showed either an inability to execute certain movements on command or misused familiar objects. Under the name of asymboly there also was described a loss of images of palpation, of kinetic movements and of the use of objects. The term asymboly has also been applied to an imperfect grasp of the nature and use of common objects, such as occurs in confusional or delirious states. In a review of the question of tactile aphasia,[2] I pointed out that the term can also be used to designate not only a failure to know the shapes of objects and their cardinal qualities, but also the ultimate recognition of the objects

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[1] The following is a bibliography of Liepmann's principal writings on apraxia.

A. Das Krankheitsbild der Apraxie (Motorischen Asymbolie) auf Grund eines Falles von einseitiger Apraxie—Monat. f. Psychiatrie u. Neurologie—Bd. VIII.

B. Der weitere Krankheitsverlauf bei dem einseitigen Apraktischen und der Gehirnbefund auf Grund von Serienschnitten—*Ibid.*—Bd. XVII and XIX.

C. Ueber Störungen des Handelns bei Gehirn-Kranken—1905.

D. Drei Aufsätze aus dem Apraxiegebiet—1908.

(This monograph is a collection of three previously published articles on apraxia—Kleine Hilfs-Mittel bei ber Untersuchung von Gehirn-Kranken—(1905). Ueber die Function des Balkens beim Handeln und die Beziehungen von Aphasie und Apraxie zur Intelligenz. (1907) Die linke Hemisphere und das Handeln (1905).

E. The section Die Krankheiten des Gehirns in Lehrbuch der Nervenkrankheiten (Herausgegeben von Hans Curschmann—1909) is by Liepmann and contains a summary of his latest views on apraxia.

F. Ein Fall von linksseitiger Agraphie und Apraxie bei rechtsseitiger Lähmung (Liepmann and Maas)—Jour. f. Psychologie u. Neurologie—Bd. X, 1908.

G. Ein neuer Fall von motorischer Aphasie mit Anatomischen Befund (Liepmann and Quensel)—Monat. f. Psychiatrie u. Neurol. Sept., 1909.

[2] The Question of Tactile Aphasia—Journal Abnormal Psychology—Vol. I, No. 6, 1907.

themselves. In its broadest sense, therefore, basing it at least upon the available data of our clinical analyses, we may say that apraxia in general is motor perplexity plus a disorder of identification. Apraxia may be divided into the motor and ideational forms. In motor apraxia the limbs do not obey the psychical wish: there is pure motor perplexity. The motor memories for movements of the limbs may be preserved but these memories are distorted, isolated or insufficiently connected with other portions of the cortex. In motor apraxia there is also a defect in the use of objects, although the objects may be perfectly recognized. The subject merely fumbles with objects; he is unable to translate a subjective purpose into an objective action. In ideational apraxia or agnosia the subject misuses objects because there is a disturbance of identification. For instance, he may think a comb is a cigar and so put it in his mouth as if smoking it. The term apraxia should therefore be limited to certain motor disorders, and it is best to refer to the ideational disturbance as agnosia.

Before the case of unilateral apraxia came under Liepmann's observation, the patient was believed to be suffering from aphasia and post-apoplectic dementia. The principal physical symptoms in this case were left facial paralysis, unequal pupils and weakness of the left leg, but no real paralysis of any of the limbs. There was pure motor aphasia and some alexia, but no word deafness, mind blindness, hemianopsia or unilateral psychic blindness. There was a marked disorder of the stereognostic sense and slight hypoesthesia of the left hand. Orientation, memory and attention were normal. The movements of the right arm were poorly executed, ill-directed and fumbling. With the left leg and arm, however, everything was correctly done. It was demonstrated, after careful study, that a typical right-sided motor apraxia was present. The analysis of this peculiar psychic condition presented many difficulties, but it was at last successfully accomplished. With the right hand responses to simple orders, such as touching the nose or buttoning the coat, and the imitation of movements were incorrectly done and with much fumbling. All commands, however, were correctly and promptly executed with the left hand. The patient blundered at every attempt to use objects with the right hand. For instance when a comb was placed in his right hand he would put it behind his ear like a penholder. Writing was defective with the right hand; the left hand produced mirror writing. For further clinical details the original monograph should be consulted.

The interpretation of the symptom complex in this case is a striking example of what may be accomplished by careful

clinical observation. Word blindness and word deafness were both absent, as all orders, movements and likewise the imitation of movements, were correctly performed with the left hand. The question may be raised that because the patient identified and correctly used objects with the left hand, and not with the right, there existed a right unilateral psychic blindness. This objection had no basis in fact, because objects placed in the right visual field were promptly identified. Because of the above condition Liepmann believed that the apraxia was not dependent on defective recognition of objects. In attempting an explanation of the condition he stated that the centripetal stimuli from the limbs on the right were perceived in the left sensory-motor area of the brain (the anterior and post-central convolutions and probably a portion of the parietal lobe), but on arriving there the impulses were blocked and therefore not transmitted to other cerebral centres. The left sensory motor area was therefore cut off from all communication with the rest of the cortex. The patient had lost the kinetic memories of movements of the right side because the left or leading hemisphere was isolated. He perceived the position, movements and tactile sensations of his limbs on the right, but was incapable of synthesizing these elements. The localizing diagnosis of the condition based on the clinical symptoms, showed how carefully the case was observed and analyzed, particularly if this be compared with the later anatomical findings. Because of the absence of word deafness, paralysis, sensory disturbances, hemianopsia, or psychic blindness, the corresponding brain centres must have been intact. The motor aphasia indicated a lesion of the third left frontal convolution and probably of the insula. The motor area and the gyrus angularis could not have been involved, because there was no paralysis and no symptoms pointing to the central optic tracts. The supra marginal gyrus and superior portions of the parietal lobe were probably destroyed. The corpus callosum was probably also involved in the process, because of the interruption of communication with the right hemisphere.

The patient died two years later from an apoplectiform attack. The anatomical findings corresponded in a remarkable manner with the earlier localizing diagnosis. The autopsy showed in the left hemisphere two foci of softening in the third left frontal convolution and a subcortical cyst in the inferior portion of the ascending parietal convolution. In the right hemisphere there was a destruction of a majority of fibres for the face and limbs on the left side, and foci of softening in the supra-marginal and angular gyri. The corpus callosum had entirely disappeared, with the exception of

the splenium. The serial sections of the brain showed these lesions with great clearness. The degeneration of the corpus callosum and of the tapetum, the softening and degeneration of the right internal capsule, the cyst of the insula and the shrunken inner nucleus of the right thalamus, were well marked. This degeneration of the corpus callosum is an important point, for Liepmann has shown that the left hemisphere is influenced by the motor region of the right cortex through the fibres of corpus callosum, and when these fibres are destroyed, the left hemisphere becomes isolated.

It was not long before Liepmann's work was confirmed by other investigators. The fundamental difference between apraxia and aphasia was recognized by Oppenheim, and later Pick reported an arterio-sclerotic and senile case in which apraxic symptoms were episodic. In a case reported by Liepmann and Maas, there was a right-sided paralysis with a left-sided agraphia and apraxia. The agraphia may be regarded as merely one of the manifestations of the apraxia. The right hemisphere was intact. In the left hemisphere, however, there was an area of softening involving the whole of the left half of the corpus callosum. In the serial sections of the brain the softening could be traced along the whole left side of the corpus callosum from the knee through the body to the splenium. In interpreting their case the authors stated that the left-sided apraxia was due either to the separation of the left hand from the memory centres of the left hemisphere, or perhaps the direct pathway for impulses to the sensory-motor area of the right brain had been destroyed. In Strohmayer's case,[1] in which aphasic and ataxic symptoms were absent, and the muscular and palpation senses intact, the patient recognized and named objects correctly, but misused them. Anatomically there was found a lesion of the left inferior parietal lobe, the supra-marginal gyrus, the forceps major and the superior longitudinal bundle. The gyrus angularis was not involved. Abraham[2] observed apraxic phenomena in two general paralytics and in a later contribution he reported a case of unilateral apraxia which on autopsy showed a lesion of the superior parietal lobe on the left. In Marcuse's case the apraxic symptoms were due to a general senile brain atrophy.[3]

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[1] *Strohmayer:* Ueber subcorticale Alexie mit Agraphie und Apraxie, Deut. Zeit. f. Nervenheilkunde, Bd. XXIV, 1903.

[2] *K. Abraham:* Ueber einige seltene Zustandsbilder bei Progressiver Paralyse—Allg. Zeit. f. Psychiatrie, Bd. LXI. 1904.

Ibid.: Beiträge Zur Kenntnis der motorischen Apraxie auf Grund eines Falles von einseitiger Apraxie—Centralbl. f. Nervenheilk. u. Psychiatrie. Mar. 1-15, 1907.

[3] *Marcuse:* Apraktische Symptome bei einem Fall von Senile Demenz. Centralbl. f. Nervenheilk. u. Psychiatrie, Dec., 1904.

Here the defects of the voluntary acts were caused by a continuous amnesia. The patient would probably forget the course of a movement after it was once started, in the same way that the tactile asymboly reported by Bourdon and Dide, was due to a kind of a continuous amnesia for tactile impressions.[1] However, very extensive amnesias may be free from any form of apraxia, as in the Lowell case of amnesia, a proof that these particular disorders of memory play little or no part in the mechanism of apraxia.[2] Pick insists strongly on the psychic element in all cases of apraxia.[3]

D'Hollander[4] has reported two cases of apraxia. The first of these occurred in a case of focal general paralysis and was bilateral. Anatomically nothing was found which could explain the condition other than the significant point that the left hemisphere of the brain was smaller than the right. In the second case, one of alcoholic dementia, there gradually developed a slight paralysis of the right arm and leg with a left-sided apraxia, thus showing the supremacy of the left hemisphere in the execution of voluntary movements. For localizing diagnosis the author suggested a lesion on the left side of the brain extending to the central semiovale, and involving the callosal fibres that go from the left to the right hemisphere.

Goldstein[5] has reported a case in which after the disappearance of a left-sided paralysis there appeared a motor-apraxia limited to the same side. For localizing diagnosis he suggested a lesion in the subcortex of the right central convolution, damaging its connections with the frontal lobe and involving the fibres of the corpus callosum. A year later, an anatomical examination disclosed, among other things, a complete destruction of the corpus callosum throughout its whole extent.[6]

In Rhein's[7] case the right hand was apraxic; apraxic phenomena were present in chewing and walking while the left hand was capable of only elementary reflex acts. The pos-

[1] *B. Bourdon* and *M. Dide:* L'Année Psychologique, 1904. (See my abstract in the *American Journal of Psychology*, April, 1905, pp. 252-254.)

[2] *Isador H. Coriat:* The Lowell case of Amnesia, Journal Abnormal Psychology, Vol. II, No. 3, 1907.

[3] *A. Pick:* Studien ueber Motorische Apraxie, 1905.

[4] *F. D'Hollander:* Bulletin de la Société Médicine Mentale de Belgique, 1907–8 (an excellent summary of all the literature, with a report of two personal observations).

[5] *K. Goldstein:* Zur Lehre von der motorischen Apraxie, Journal f. Psychologie u. Neurologie, Bd. XI. H. 4-5-6-.

[6] Der makroskopische Hirnbefund in meinem Falle von linksseitiger motorischen Apraxie, Neurol. Centralblatt., Sept. 1, 1909.

[7] *J. H. Rhein:* A case of apraxia with autopsy. Journal of Nervous and Mental Disease, Vol. 35, Oct., 1908.

terior portion of the corpus callosum was found degenerated at autopsy.

In Vleuten's[1] case, there was a sarcoma in the left hemisphere, which by invasion and pressure destroyed the cingulum, the whole of the left half of the corpus callosum and part of the right genu. The right hand and arm was tremulous, while the left hand and arm showed apraxia. Here the left-sided apraxia was produced by a lesion which destroyed the callosal fibres. Bychowski[2] has reported a case in which the apraxia was found to be due to a cyst in the left hemisphere which destroyed and displaced a portion of the left side of the corpus callosum. In Hartmann's[3] three cases of apraxia, one was due to a tumor in the left frontal region, and the second to a tumor involvement of the corpus callosum. In a case recently reported by Tooth[4] there was an inconstant motor-apraxia of the left hand. At autopsy there was found a tumor occupying a portion of the right frontal lobe, involving the anterior half of the corpus callosum.

In discussing the psycho motor disturbances of various mental diseases Kleist has shown how apraxic phenomena may appear in the hyperkinetic and akinetic motility psychoses. He thinks that these disturbances are probably due to psychic factors and that they may have a definite cerebral localization, particularly in the parietal lobe.[5] This is of interest if we remember that in some cases of unilateral motor apraxia, the parietal lobe was found involved as well as the corpus callosum. For instance in one case of an akinetic motility psychosis which came under personal observation, it was noted that the subject had lost all knowledge of the use of simple objects. Stransky[6] has shown how apraxic phenomena may appear in dementia præcox. In these cases he interprets it as due to a loss of unity between the understanding and the will.

Apraxia may also occur as a disorder of consciousness in delirium and post-epileptic states and under both these conditions without any definite focal lesion. Here the apraxia

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[1] *C. F. V. Vleuten:* Linksseitige motorische Apraxie, Ein Beitrag zur Physiologie des Balkens, Allg. Zeit. f. Psychiatrie, 1907.

[2] *Z. Bychowski:* Beiträge zur Nosographie der Apraxie—Monat. f. Psychiatrie u. Neurologie. Bd. XXV, 1909.

[3] *F. Hartmann:* Beiträge zur Apraxielehre, Monat. f. Psychiatrie u. Neurologie. Bd. XXI, 1907.

[4] *H. H. Tooth:* (Abstract in Review Neurology and Psychiatry, July, 1909, pp. 475-476.)

[5] *K. Kleist:* Untersuchungen zur Kenntnis der psychomotorischen Bewegungsstörungen bei Geisteskranken, 1908.

[6] *E. Stransky:* Zur Auffassung gewisser Symptome der Dementia Præcox, Neurol. Centralbl., Dec., 1904.

is ideational, in the sense of a disorder of indentification. In these cases the phenomena tend to disappear as the mental state improves. In my study of a delirious state associated with vestibular disturbances, apraxic phenomena were present.[1]

Motor apraxia has been found to occur in aphasia. The disorders of movement which one frequently finds in aphasics are very likely not due to any intellectual defect as claimed by Marie, but to a disorder independent of aphasia, namely apraxia. Cases of dementia very rarely show symptoms of apraxia. It cannot be said that apraxia is due to any intellectual disorder because in disturbances of motility where the apraxia is limited to one side of the body, the other side of the body will be found to be absolutely normal. This shows that intellectual defects may be practically ruled out in motor apraxia, at least in the unilateral types, unless it is absurdly assumed that only one side of the brain is demented. In one of my cases of sensory aphasia the patient was bright and alert and yet he ridiculously insisted on eating an egg, shell and all. Here we have an example of apraxia occurring in an aphasic subject without mental defect. Ideational apraxia (agnosia), however, may occur in certain abnormal mental states, such as in delirious conditions or in multiple brain lesions.

There are many striking points of similarity between motor aphasia and motor apraxia. The motor speech mechanism is really a form of movement without objects. The centre for motor speech is located in the left hemishpere and it has also been shown how the kinetic memories for co-ordinated movements likewise preponderate in the left hemisphere, at least in right-handed subjects. In complicated movements which through habit and evolution, have become bilateral, such as the lip-tongue-larynx movements in speech, there is usually a loss of these movements in a lesion of the motor speech area. In the limb movements which as a rule are not bilateral, but in which right and left are independent and in marked contrast, there results a unilateral apraxia when a lesion on one side of the brain is favorably situated.

How then are we to explain these complex phenomena and what light can be thrown upon them by brain anatomy and physiology? Certainly the subject of apraxia opens up one of the most inviting and at the same time one of the most difficult fields in psychopathology. At first it will be well to attempt to analyze apraxia on the basis of the data furnished by those cases where it was possible to make an anatomical examination of the brain.

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[1]The Cerebellar-Vestibular Syndrome, American Journal of Insanity, Vol. LXIII, No. 3, Jan., 1907.

The point of significance in the majority of apraxic cases was the involvement of some portion of the corpus callosum. The corpus callosum must then be possessed of a definite function, as its involvement seems to have been as invariably present in motor apraxia as a lesion of Broca's convolution in motor aphasia or of the central optic tracts or the cuneus in hemianopsia. What then is the function of the corpus callosum and how are we to harmonize the motor and psychic disturbances with the anatomical findings?

The fibres of the corpus callosum connect the two opposite sides of the brain. In fact in experimental lesions of the thumb centre in monkeys, the degenerated fibres could be traced directly through the corpus callosum to a similar area on the hemisphere of the opposite side. The knee of the corpus callosum sends its fibres to the fore brain as the forceps anterior. The fibres of the splenium go to the hind brain (occiptal region) and to the temporal lobes as the forceps posterior and make up the greater part of the tapetum. The body of the corpus callosum connects the two hemispheres in the mid position. Both the left and the right hand centres, corresponding respectively to the movements of the right and left hands, are connected by means of the fibres of the corpus callosum.

By reason of its wide connections, the corpus callosum plays an important part in the execution and association of voluntary movements. In tumors of the corpus callosum, disorders of movements are frequently seen, such as apraxia, tremor and ataxia. In a case of tumor of the splenium of the corpus callosum which came under personal observation, there was a paralysis of the right arm and of the right side of the face and a continual coarse tremor of the left arm. A lesion of the corpus callosum alone causes a left-sided motor apraxia without paralysis or apraxia on the right. A lesion of the left hand centre causes paralysis on the right side and apraxia on the left. It seems that certain left-sided lesions produce a left-sided apraxia because the control of the right hemisphere over the innervation of the left arm by means of the corpus callosum has been cut off. The left hemisphere thus becomes isolated and leaderless.

The following diagram will indicate the various brain lesions which may produce motor apraxia.

(See figure I.)

A lesion at I (the left brain centre for the right arm) will produce a paralysis of the right arm and an apraxia of the left arm because this centre is either isolated or is deprived of the guidance of the right hemisphere. A lesion at II (in the subcortex of the left Rolandic area), injuring the

projection and callosal fibres to the right hemisphere, will also produce a paralysis of the right arm and an apraxia of the left for the same reason as indicated under lesion I. A lesion at III (the left internal capsule) will cause a right-sided paralysis, without any apraxia on the left, because the corpus callosum is not injured. A lesion at IV (in the corpus callosum) will cause a left-sided apraxia. A lesion at V (in the left centrum ovale, catching only callosal fibres) will likewise cause a left-sided apraxia. In both these conditions,

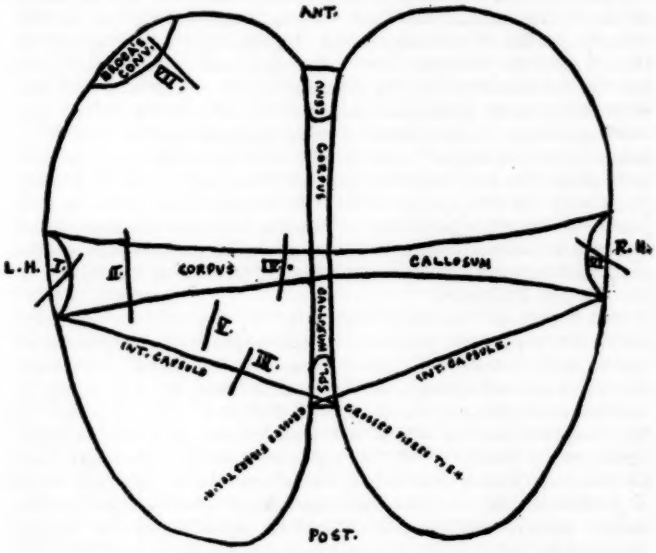

Fig. I

A diagrammatic horizontal section of the brain, to illustrate the anatomical basis of motor apraxia.

L. H. Left brain centre for right hand.
R. H. Right brain centre for left hand.

The anterior and posterior and the lateral course of the fibres of the corpus callosum are shown diagrammatically.

the apraxia is due either to a loss of the guiding influence of the right-hand centre over the left hand or to an isolation of the hand centre from the rest of the left hemisphere. A lesion at VI may cause a right-sided apraxia from an interruption of the callosal fibres passing to the left side of the brain. (Liepmann's first case.) A lesion at VII (Broca's convolution) would

produce motor aphasia, and if the lesion be of sufficient size and extent to catch the radiations of the genu of the corpus callosum (or forceps anterior), there will be likewise caused a left-sided motor apraxia. That this latter combination is not impossible, is shown by the case recently published by Liepmann and Quensel and also by the second of my reported cases.

We must admit that the psychical condition of apraxic subjects presents great difficulties of analysis, even more so than the analysis of disturbances of the language mechanism in the various types of aphasia. Probably with increasing knowledge of apraxia some of these difficulties may be overcome. Motor apraxia in its strictest sense is rarely bilateral as can be easily seen from the reported observations. It is in ideational apraxia or agnosia that the bilateral nature of the disturbance may be detected. In fact, agnosia seldom or never occurs as a pure isolated disorder in focal brain disease. When it does occur in focal disturbances of the brain, it is merely as a complication of the motor type of apraxia. Agnosia is most frequently found in diffuse brain affections (senile dementia), in delirious states particularly due to epilepsy or alcohol or in the motility psychoses. Hence agnosia is a more general disturbance, while apraxia is a focal disorder limited to certain limbs or to muscle groups.

In motor apraxia the limbs do not obey the psychical wish, although that wish and the motor image of the willed movement may be clearly present in the mind of the subject. It is this inability, on the part of the subject, to transfer the psychical wish into a specified innervation of a limb, which causes motor apraxia. In ataxia it is the elementary condition of the movements which is at fault, while in apraxia there exists a disharmony between the purpose of the movement and the idea of the object with which the purpose is carried out. In other words, in motor apraxia there is a deficient adjustment to a purpose. In motor apraxia the coordination of movements is normal, but there is a faulty intrapsychic process and so the ultimate purpose of these movements becomes incorrect. The motor apraxic cannot translate the subjective idea of a movement or of the use of an object into its objective reaction. Motor apraxia therefore may originate from either an insufficiency of the directing idea, from derailment or irradiation of the directing idea upon the neighboring ideas, from the omission of portions of the motor act and the predominance of the last portion of the act or from the substitution of the directing idea by another idea.

All normal voluntary activities seem to be due to two

mechanisms—the representation in the sensory sphere of the successive series of partial acts which make up the entire act (the kinetic formula for movements) and the faculty of changing this sensory representation into external movements (the ability of exteriorization). The kinetic formulæ for movements are really the memories of successive movements and can be compared to certain chain or sequence reflexes, a point upon which I had previously insisted in my studies on amnesia. In motor apraxia, this kinetic formula is defective. Therefore it acts in an abnormal manner upon the innervation of the specific action, according to which of the kinetic elements is disturbed. Motor apraxia consists, therefore, in a rupture of the physiological connections between the innervation of a specified limb and the ideas concerned in the carrying out of a specified purpose. It is really a motor dissociation, in which special kinaesthetic memories lie outside of the field of general motor innervation. This isolation of the kinæsthetic memories is probably due to an isolation of a certain portion of the left hemisphere in which these motor memories are stored up, an isolation resulting in most cases, from a rupture in the conduction of the fibres of the corpus callosum. The centripetal stimuli reach the centrifugal pathway without entering the special ideational or motor centres by a kind of "short circuit." This is pure motor apraxia; when in addition there exists a disorder or identification, we have motor apraxia plus asymboly or ideational apraxia (agnosia). In all cases of motor apraxia the chief difficulty seems to lie in the inability of the subject to transfer the directing ideas or rather the willing of the directing ideas to the motor sphere because they are partially cut off, isolated or derailed.

The behavior of apraxic patients is a subject of much interest. Movements of substitution which are so common in motor apraxia, may be compared to paraphasia. Occasionally the subject may begin a movement and only partly complete it. Here the reaction is referred to as curtailed. Sometimes a movement may bear no resemblance whatsoever either to the usual acts of everyday life or to a specially skilled reaction. Unde these conditions we describe it as a formless or an amphorous reaction. On still other occasions the first part of the movement may be immediately followed by the last part without any intervening motions. This is called a short circuited reaction ("Kurzschluss Reaktion"). Perseveration is the monotonous automatic repetition of an act. Sometimes indeed the subject becomes petrified, as it were, in the attitude of executing a simple or a complex act either requested or spontaneous. To the first form is applied the term clonic perseveration; the latter is known

as tonic perseveration. Clonic perseveration strongly resembles the recurrent utterances of sensory aphasia, while tonic perseveration is analogous to the mutism of a severe motor aphasia.

Scheme of disturbances of kinetic formula for movement.

A —⟩ B —⟩ C —⟩ D = Normal Motor Reaction.
A ————————⟩ D = Short Circuited Reaction.
A —⟩ B = Curtailed Reaction.
A —⟩ A —⟩ A—⟩ = Clonic Perseveration.
A = Tonic Perseveration.

FIG. II.

A graphic analysis will make this clearer (see figure II). Let A. B. C. D. represent the kinetic formula for a certain movement, each letter indicating one element of the action. The normal movement could occur only when the individual elements acted serially. Any change in the position of the elements or any omission, would result in disordered activity or apraxia. For instance if the action took place as A-D. with the intervening elements omitted, we would have a short circuited reaction. If the movement was A—B. with the other two elements omitted, then the action ceases soon after it has been started; in other words, it has become curtailed. If the action should be A. A. A, the first portion of the action will then tend to be indefinitely repeated. A clonic perseveration could result. If the action was A. alone, and no further elements of the kinetic formula followed, the subject then would become stuck at the first of the series. Here we have a tonic perseveration. Many apraxic subjects show a marked lack of spontaneity, a condition which strongly resembles, if it is not identical with tonic perseveration. As a rule most requested or spontaneous movements in apraxic subjects are ill directed and fumbling, show a deficient adjustment to a purpose and yet they are not ataxic.

Von Monakow[1] has brought forth an ingenious theory to explain certain focal disturbances of the brain, particularly aphasia and apraxia. According to this theory, mere anatomical interruption of the continuity of fibres in the central nervous system will not fully explain the various form of focal disorders. Therefore there must be a special form of action at a distance from which may arise temporary or permanent suspensions of function. To this action at a distance, von Monakow applies the term "diaschisis." This diaschisis resembles certain physiological irradiations, in which a reflex effect can spread in various directions from a focus of reflex discharge.

[1] *Von Monakow:* Neurol. Centrablatt, Nov. 16, 1906.

The study and analysis of two cases of motor apraxia which came under personal observation will now be taken up. The difficulty of correlating the motor reactions with the mental state of the subject will excuse the lengthy details of the reports. In fact, in apraxia as well as in aphasia, a rigid examination scheme has but a limited value, as not only do the types and the conditions vary, but the same type may present different aspects in different subjects. Our present knowledge of apraxia is due entirely to minute clinical investigations, to which, when possible, the anatomical findings have been added.

Case I. When the patient K., who was twenty-four years of age, first came under observation he had been suffering from severe headaches for two months. On several occasions the headaches became so intense that vomiting followed. Up to this period the patient had been perfectly healthy. An examination disclosed the following condition. Only the essential neurological details are given. Tongue tremulous and protruded to the right, tremor of outstretched hands, the right knee jerk and right Achilles jerk were brisk; while the left knee jerk and the left Achilles jerk were absent. There was a subjective sense of weakness and numbness on the left side of the body. There was no ankle clonus or Babinski reflex. The pupils were equal and reacted promptly to light and accommodation; there was no paralysis of the ocular muscles and no nystagmus, but an ophthalmoscopic examination disclosed a blurring of the optic disc without swelling (beginning optic neuritis).

About three weeks later a sudden but transitory paralysis of the left arm and leg took place. Within a few days this improved until only a slight weakness could be detected. The physical condition has since remained the same with the exception of a blunted sensation in the left hand, associated with a weakness of grasp. Word deafness and motor aphasia were absent during the entire course of the disease. The patient was right-handed.

There was no hemianopsia and no unilateral mind blindness, because objects placed in each visual fields were promptly recognized. An analysis showed a typical motor apraxia of the left arm, while the right arm was entirely free from any motility disturbance. This unilateral apraxia was not dependent on any defective recognition of objects, because the patient could correctly select objects with either hand, but did not know how to correctly use them with the left hand after they had been selected. He was always oriented, and there was no disorder of memory either for recent or remote events. Unilateral agraphia was absent; he was able to write spontaneously and to dictation fairly well with either hand.

There was no apraxia of the left leg or of the muscles of facial expression for either side. This appearance of a motor apraxia in a limb from which a previous transitory paralysis had disappeared, resembles the observation of Goldstein, to which we referred above.

Examination for Apraxia, Motility and Sensation of the Left Arm

The general movements of the left arm were weak and fumbling. The dynamometer for the right hand registered seventy, while for the left hand it was twenty. The left arm was not paralyzed and all the movements could be fairly well performed but they were ill-directed and awkward. The abnormal motor reactions of the left arm on analysis seemed to be entirely due to a motor apraxia and not to any motor weakness or ataxia. With the eyes closed the movements of the left arm were decidedly more fumbling and ill-directed than when the eyes were open. In spite of the fumbling and slight weakness and spasticity of the left arm, he could spontaneously lift it above his head, flex, extend, pronate, supinate, fairly well extend and flex the fingers and give a fair grasp, although there was a disinclination on the part of the subject to spontaneously use this left arm. This tendency to akinesis was probably due partly to the patient's appreciation of his localized motor apraxia and partly to a state of tonic perseveration. An examination of the sensation of the left arm, forearm and hand showed anæsthesia and hypoalgesia.

The testing of the muscular sense of position showed that when the right forearm was placed at a right angle to the right arm, after some fumbling he was able to correctly imitate the position with the left arm. When the right arm was placed vertically above the head he promptly placed the left arm in the same position. With the eyes closed, when the right arm was passively elevated above the head and the patient was requested to imitate the position with the left arm, he merely placed the latter horizontally on the same level with the shoulder. Right arm passively extended horizontally forward with the palm upwards; he imitated it by placing the left arm in the same position but with the palm downwards. Right index finger placed at right angles; with the left hand he merely made a fist.

Reaction to Requests

	R. Hand	*L. Hand*
Buttoning coat	Correct	Grasps edge of coat
Touching tip of nose with right forefinger	"	Puts palm to mouth
Touching right ear with right fore finger	"	Places finger back of head

	R. Hand.	*L. Hand.*
Movement of sewing	Correct	Fumbles
Movement of cutting with scissors	"	Fumbles
Snapping fingers	"	Makes fist
Turning hand-organ	"	Makes fist
Movement of turning key in lock	"	Makes fist
Movement of shaving	"	Places hand behind ear
Movement of combing hair	"	Rubs head with palm of hand
Movement of use of cork-screw	"	Fumbles
Military Salute	"	Fumbles

In the three successive reactions with the left hand in which the patient made a fist in response to different requests, we have an example of clonic perseveration or the frequent monotonous repetition of an act.

Reaction to the Use of Objects

	R. Hand	*L. Hand*
Comb	Correct	Rubs hair with smooth back of comb
Tooth brush	"	Correct but fumbles
Hair brush	"	Holds back of brush several inches above head without any brushing motion
Key	"	Cutting movements as though it were a knife
Match	"	Correct but fumbles
Spoon	"	Cutting and stabbing movements
Cigarette	"	Grasps it clumsily, puts it to chin and then puts wrong end in mouth

In the reaction to requests and to the use of objects the left-sided apraxia became more marked when the patient's eyes were closed. The same fact was noted in testing for the sense of position in the apraxic limb. For instance, in one series of tests a key, a match and a drinking glass were used correctly with the right hand and decidedly awkwardly and fumblingly with the left. When attempts were made to use these same objects with the eyes closed, the left hand seemed to become petrified, as it were, after an abortive start. In other words we seem to have here the phenomenon of tonic perseveration. On other occasions, even with the eyes open, he would start to use an object correctly with the left hand, and then would hopelessly fumble, either going into a condition of tonic perseveration or would finish up with a substituted movement, as if the object or the request had been changed. Sometimes, too, in the use of objects with the left hand, the movements would bear no relation to the nature of the object; they would become decidedly amorphous. The stereognostic sense was entirely lost on the left hand and to a certain extent, at least for larger and coarser objects, on the sole of the left foot. The increase of apraxia when the eyes were closed, was not due to any astereognosis, because the patient was always told the nature of the object. At no time

was there any loss of the knowledge of the use of objects. He was always able to describe their uses and from a number of objects spread before him he was able, on request, to pick out the correct one with either hand. The patient always knew when he used an object incorrectly with the left hand. The apraxia seemed therefore not dependent on any defective recognition of objects; in other words, it was not ideational but was almost entirely a motor disorder. His knowledge of the use of objects was always correct, even when he was not permitted to touch the objects.

In order to further show that there was no disorder of identification and that the inability to correctly use objects with the left hand was purely a motor disturbance, the following observations are of interest. When the patient was shown a match and requested to describe its use, he replied "To make fire." When asked to show the use of a match he did so correctly with the right hand. With the left hand, however, he clumsily grasped the entire match in his fist, leaving only a small portion of the head exposed and then made stabbing instead of scratching motions with it. When a cigarette was given to him, with the right hand he correctly placed it in his mouth. With the left hand he grasped the cigarette so clumsily in his fist that it was almost broken in half, then he placed it to his chin, then after some hesitation brought his fist to his mouth, still holding the cigarette tightly and with the mouth end completely covered up with his hand. When a match-box was placed in the left hand he promptly opened the cover, took out a match and showed correctly how to use it. When the match-box was placed in the right hand, attempts to repeat the performance with the left hand brought out a very typical motor apraxia. After considerable fumbling and perplexity he opened the cover, took out each match separately and allowed each to fall back into the box without any attempt at scratching them. When a pipe was placed in the right hand he promptly put the stem in his mouth. With the left hand, however, he took it by the bowl and placing the bowl to his chest said "I know it is a pipe, but I can't use it with this hand." It appears that these details point out the significant fact that the inability to use objects with the left hand was due not to any lack of knowledge or identification of the object, but to a derailing of a motor wish into a false motor reaction.

The imitation of movements also brought out a left-sided motor apraxia as follows:

	R. Hand	*L. Hand*
Saluting	Correct	Fumbles
Shaving	"	Merely places hand on cheek
Shining shoes	"	Grabs ankle

When requested to perform these same actions with the left arm and the eyes closed, fumbling and lack of direction in movements became greatly increased. It seems from these observations that visual impressions could partially correct the left-sided motor apraxia. When the visual stimuli were cut off by having the patient close his eyes, he went completely off the rails. The movements of the left hand without objects, were as apraxic as when objects were used.

In this case we are probably dealing with a brain tumor for with the following localizing diagnosis may be suggested. The tumor is probably in the right motor sub-cortex or centrum ovale, involving a portion of the fibres of the pyramidal tract and of the parietal region and probably a large portion of the fibres of the corpus callosum. A lesion here from its position could cause the motor disturbance of the left side of the body, that is, a transitory paralysis and weakness of the left arm and to a slighter extent of the left leg, and also a typical motor apraxia of the left arm. This latter is due to a loss of the guiding and directing influence of the right arm centre upon the left arm through a destruction of the fibres of the corpus callosum.

In the second observation we have the combination of an aphasic speech disturbance and a left-sided motor apraxia, both occurring in a right-handed subject. Such a combination is of importance, for it demonstrates that a left-sided brain lesion may be so situated as to cause an aphasia and a left-sided apraxia.

Case II. The patient L., 57 years of age, a right-handed man, began to suffer with a severe headache localized on the left side of the head, combined with dizziness and a weakness of the right arm. Shortly afterwards he suddenly began to repeat "oilcloth, oilcloth" spontaneously and in reply to all questions. This recurrent utterance lasted about an hour, after which speech became normal, although a little dysarthric. Somewhat later that same day he again suddenly began to talk in a jargon. In this jargon German sounds (his native language) predominated, while all knowledge of English (an acquired language) was completely lost. This condition lasted for four days and during this time the left-sided headache, dizziness, weakness and numbness of the right arm and leg continued although no actual paralysis was ever noticed. All requests and commands were understood. He knew the hours for meals and his various wants of his everyday life. At the end of four days he suddenly regained his normal speech in both languages. Since then when fatigued or frequently in the late afternoon he will forget the names of objects in English and will call them only by their German names. This is a

feature of interest which I had previously pointed out in the Lowell case of amnesia. It is indicated that the acquired memories in certain forms of amnesia were the first to disappear, while the deeper and more closely knit associations were preserved.

The neurological examination may be briefly summarized as follows: Marked arterio-sclerosis with a high blood pressure, speech occasionally dysarthric, no hemianopsia, grip of right hand decidedly weaker than that of left, no paralysis, pupils slightly unequal, the right reacting slightly to light, the left rigid, the right knee jerk diminished as compared to the left, no Babinski reflex, no facial paresis or deviation of the tongue. The gait was weak but not hemiplegic while the station was normal. There were no sensory disturbances in any of the extremities. All objects were quickly and correctly recognized and named and their uses accurately described. The amnesic aphasia was episodic and usually appeared only after the fatigue of a long examination or in the late afternoon. The patient was clearly oriented and showed no signs of intellectual defect.

An examination of the motility of the left hand showed that while it was slightly weaker than the right, it was free from paralysis, ataxia or tremor. All voluntary movements were present, yet it was possible to demonstrate a typical left-sided motor apraxia. The false motor reactions of the left hand were due to a motor apraxia and not to any inability to understand requests, because there was no intellectual defect and no word deafness. The facial muscles were free from apraxia. The inability to name objects, although he could indicate their uses with the right hand, took place only during the temporary anmesic aphasia due to fatigue. Repetition of printed letters was normal. Copying was correctly done with each hand. All objects were correctly recognized in each visual field and therefore there was no unilateral mind-blindness. Astreognosis was absent. The apraxia may be tabulated as follows:

REACTION TO REQUESTS

	R. Hand	*L. Hand*
Making a fist	Correct	Correct
Spreading the fingers	"	Shows palm of hand
Using cork-screw	"	Fumbles, first part of action correct, then makes cutting instead of pulling movements
Saluting	"	Correct
Smoking a cigar	"	Saluting movements

The attempt to show the use of a cork-screw with the left hand is an example of a curtailed reaction, while the persist-

ence of saluting movements to different requests indicates a clonic perseveration.

REACTION TO USE OF OBJECTS

	R. Hand	*L. Hand*
Scissors	Correct	Fumbles but correct
Key	"	Turns it upside down and holds it there
Match	"	Holds it like a pencil and makes writing motions
Pencil	"	Correct
Shoehorn	"	Rubs it against leg

A number of other objects were correctly used in the left hand but in a fumbling and awkward manner. The imitation of movements was also somewhat apraxic on the left. The imitations of movements of the right arm with the left arm led to some interesting reactions. When the patient was requested to make certain movements with the left arm alone, an apraxia always resulted, but this apraxia practically disappeared if the patient was allowed to imitate the movements of the right arm with his left. The apraxia to imaginary movements or in the use of objects was increased when the eyes were closed; or if apraxia was absent when the eyes were open, it tended to appear when the same tests were made with the eyes closed. These observations, demonstrated as in the previous case, that visual impressions are able to partially correct a motor apraxia in the same manner that a subject is less ataxic when the eyes are open.

For an anatomical localizing diagnosis we would suggest a probable area of softening at the angle of the third left frontal convolution and the Sylvian Fissure, extending below to the white matter of the corona radiata and to the radiations of the genu of the corpus callosum (forceps anterior). A lesion here would cause a motor aphasia and also a motor apraxia of the left arm, because the guiding influence of the right side of the brain upon the left side of the body would be cut off. The motor centre would thus become isolated. Here again we see the importance of the integrity of the callosal fibres from preventing any motility disturbance. The weakness and numbness of the right arm is probably due to either a backward extension of the lesion or to a pathological irradiation involving the anterior central convolution on the left.

Any analysis of these two cases demonstrated that the chief difficulty lay in an inability to transfer a subjective choice process into an objective reaction. The cause of this disorder could be easily traced to a definitely localized lesion in the brain, which disturbed the kinetic memories for move-

ments and produced new and abnormal combinations. The disordered movements and misuse of objects could be partially corrected through visual impressions, probably because these impressions may have stimulated certain non-affected portions of the brain, to function in a normal manner.

NOTE ON SOME OF THE PHYSICAL FACTORS AFFECTING REACTION TIME, TOGETHER WITH A DESCRIPTION OF A NEW REACTION KEY

By Frank Angell

The history of reaction-time investigations discloses a curious combination of painstaking accuracy in regard to the functioning of the time-measuring apparatus together with a more or less happy-go-lucky arrangement at the other end of the experiment.

Thus the chronoscope and its standardizing instruments have been the subjects of minute and laborious investigation, whilst the reagent, after assuming his 'convenient and comfortable position' has usually been left to his own devices in carrying out the reaction prescriptions. Whether however the reagent obeyed the directions, whether, for example, wrist and forearm movements did not enter into play where finger movements were prescribed, are matters which the experimenter has rarely been in a position to determine. Indeed it has only been of comparatively recent date that investigation has been directed to the initial pressure, the "antagonistic motion" of the break reaction.

Among other neglected factors in these experiments has been the effect of the tension of the reaction key spring. This has usually been set at a 'comfortable and convenient' resistance, and variations within these 'comfortable and convenient' limits have been regarded as negligible. This may be the case, but it is a minor question quite as well worth investigating as a variation of 2 or 3 sigma in the readings of the chronoscope.

The question was taken up as a "minor study" by two students in the advanced course in psychology— Miss Lanktree and Miss Morrison. The lever arm of a Morse key was set at tensions of 10, 20, 50, 100, and 200 grams respectively, and for each tension 10 series of 10 reactions each were taken. The first of these series does not enter into the averages given in Table I as the fall-hammer showed irregularities in the chronoscope at the time this series was taken. Each day the 5 series were run through twice—the second time reversing the order of the first, the order of the several series changing from day to day. The 15 volt current was furnished by a mercury rectifier and maintained at the same strength for

each day, usually at 0.47 amp. The mean variation of the hammer readings ran from one to three sigma—not very accurate but sufficiently so for the purposes of the experiment.[1] The stimulus came from a sound-hammer placed behind the reagent, who occupied a room adjacent to that of the experimenter. The reagents noted the condition of attention as good, moderate or strained (the last referring to the accompanying muscular tension) and in addition marked the reaction as sensory or muscular. Almost all of the reactions were characterized as sensory;—seemingly from strain sensations in the ear adapting it to the direction of the stimulus. L. had already been reagent in another investigation for more than a semester and both had been experimenting on reaction time in the second year's course of laboratory work.

Table I gives the results of the experimentation for the several tensions of the reaction key. It shows noticeable differences for all tensions in case of L. and a noticeable difference between the tension of 200 grams and the remainder of the series for M.

TABLE I

Reaction times for different tensions of spring of telegraph key. Reagents L. and M.

	L		M	
Tension Grams	r. t.	m. v.	r. t.	m. v.
10	129.8	8.0	136.9	8.6
20	127.3	7.5	136.1	6.6
50	122.4	4.9	135.2	9.1
100	120.8	7.7	135.1	10.9
200	116.0	4.7	127.0	7.9

The introspections do not indicate any marked change in the attitude of the reagents for the stronger pressures of the key. Once M. notes a strain in the hand with 200 grams, but the reaction itself is noted as sensory, *i. e.*, the sensory content of consciousness at the moment of reaction was strain sensations in the head or ears directed toward the source of sound. The increase in tension, therefore, would not seem to result for the reagent in a direction of attention to the hand and a change to the muscular form of reaction. L. asserted that there

[1]It is, perhaps, worth while to note that the chronoscope "neuerer Construction" used in this investigation, with only 4 years of use is a much less steady instrument than our old chronoscope; also "neuerer Construction" which has weathered 20 years of general laboratory service.

was no noticeable difference to her in the set of the hand for the 10, 20 and 50 grams of pressure, but that the transition from any of these to 100 grams and from 100 to 200 was marked. Nevertheless L's reactions show a steady decrease in quickness from 10 to 200 grams. The shortening of the reaction time with increase in tension of the key spring is, therefore, probably physical and due to an acceleration of the motion of the reacting finger imparted by the recoil of the spring. The tension at which the acceleration would be noticeable would depend on the manner of reaction: ten grams pressure might accelerate a finger reaction but not one from the wrist or elbow. As a result of long practice, L. had become skilled in the finger reaction. This is possibly the reason why, for this reagent, the effects of each tension were noticeable. A measurement of the rapidity of the free recoil of the spring for 10 grams of tension showed that a separation of the contacts of $\frac{1}{8}$ of a millimeter—more than sufficient to break the current—took place in 0.0005 sec. which of course is considerable faster than the reacting finger can move at the beginning of its course. This is to answer the possible objection that for the weaker tensions, the reacting finger moved up faster than the key-bar.

PART 2. EXPERIMENTS WITH TRIGGER REACTION KEY.

As is the case with much of its apparatus, experimental psychology found the ordinary telegraph key already in use and adopted it for its own purposes. The key is very convenient in manipulation and the motion it calls for is 'natural.' Serious objections to it are the antagonistic motion with the break reaction and variability of extent of the reaction motion. Another easy and natural motion is that of the finger in pulling a trigger, with the advantage of a very slight tendency, if any, towards the opposed reaction, though it may well permit an anticipatory contraction. The experiments presently to be described were carried out with a new key of the trigger type.

The elimination of the antagonistic reaction would, in itself, hardly be a sufficient reason for adding another instrument to the already long list of reaction keys. This trigger key, however, measures the force and extent of the reaction movement as well as its time. As is evident from the accompanying figure, the key is simple in construction. A cylindrical, self-registering spring balance is mounted horizontally. The movable end is provided with a ring for the reacting finger and in front of this stands an adjustable post serving as a brace for the hand. Electrical contact is made through the horizontal adjustable rod R. mounted parallel to the cylinder. This rod is connected with the binding-screw S^{11}, the other binding post S^{12}

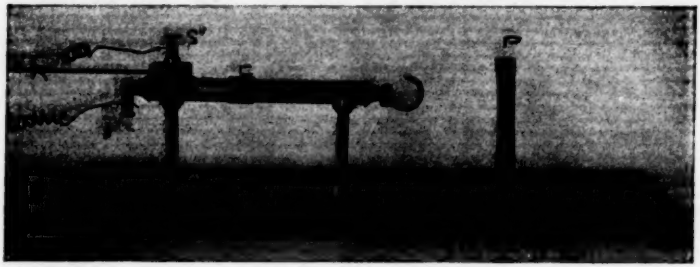

Fig. 1.

being connected with the index of the balance. In reacting, the reagent closes the hand around the post P.—adjusted to the proper distance from the 'trigger', and inserts the forefinger in the ring as far as the first joint. When the stimulus comes the reagent pulls the 'trigger', which breaks the contact between the rod R. and the scale index. The pull carries along the registering ring C. which is left in place at the forward end of the pull thus showing the force and extent of the reaction movement. If it is desired to change the initial tension of the spring, the rod R. can be pushed along the side of the scale and the spring set at any tension. In this way the influence of the initial tension on the reaction movement can be easily ascertained. Any anticipatory pull for 0 grams of tension is signalized by the failure of the chronoscope hands to move.

For the sake of comparison of the keys, pairs of series of reactions were taken with each of 10 reagents, each key being used in one series of a pair. The number of reactions in a series was 20, and one series in each pair was taken in halves with the other series sandwiched in between the halves to compensate possible practice effects. As the object of this experiment was merely to test the relative trustworthiness of the two keys, it will be sufficient to make a general statement of the results.

Although the reagents were inexperienced in reacting, the reaction times as well as the variations differed in no marked degree from those of experienced reagents with whom the processes of reaction had not passed over into the mechanical stage.

The figures showed the shorter reaction time for 7 of the 10 reagents with the telegraph key. If we were to 'guess' at the reason for this difference we should say it might in part, be due to the upward push of the key spring, and in part to the stronger tendency towards muscular reaction involved in

the reacting position for the telegraph key. With the trigger key, the hand and arm lie in a position producing less muscular strain than is the case with the Morse instrument, and no tension is required to hold in place the moving part of the instrument. Accordingly the content in consciousness of muscular strain is usually less for beginners with the trigger form of key and the reactions tend more to approach the sensory form.

The differences of proportional mean variation between the two keys were less marked than differences of reaction time and in general, so far as the data go, we should be inclined to say that taking merely the question of the time factor into account, the trigger key is as trustworthy an instrument as the old key.

Force and Extent of the Reaction Movement

So far no attention has been paid to the other factors of the reaction given by the trigger key, *i. e.*, to the factors of force and extent of pull. The object so far has been merely to compare the time data of the instruments, and with such *Versuchstiere* as beginners in psychology there is every incentive to keep the conditions of investigation as simple as possible.

The experiment that follows is a preliminary survey with one reagent of all the data given by the trigger key—the force and extent of the reaction movement in relation to each other and to the reaction time. The reagent for this purpose was Miss Shumate who had done much reacting both in the regular course of laboratory work and in investigations. Before coming to this work and during it, she had been using the telegraph key for reacting to light stimuli with variable signal. Under these conditions her reactions were of the sensory type. She had also taken part in the comparison experiment along with the unpracticed reagents, but had reacted eight periods instead of one. The results for seven of these periods (omitting the first where the data are imperfect) were:

	Tel. Key	Trig. Key
Reaction time—median of 7 series	257	225
Av. of m. v. of 7 series	26	22

A number of series was next taken with the trigger key set at different tensions from 0 grams to 1,000 grams—the reagent noting each time the extent, and consequently the force, of the reaction pull. The instructions to S. were simply to mark the condition of the tension—classing it as "high," "medium," or "low" and to note extent of pull. Reactions

which the reagent classed as of "low attention" are not included in results. The interval between signal and stimulus was varied slightly to prevent reactions from becoming mechanical. In response to inquiry, the reagent said that her motions were not influenced through noting their extent and force; in the process of reaction she had in mind chiefly the time factor with no thought of making the pulls uniform in extent.

About 40 reactions were taken each period, distributed in four series corresponding to four different tensions of the key. Under these regular conditions, with but slight interruption for introspections, the effects of practice became very noticeable, so that at the end of a month the reagent's average reaction time had decreased 75 to 100 sigma. Table II gives the figures for all the reactions of this experiment. Taking the April result, where practice effects practically disappeared, we find with this key, too, an increase in reaction time with increasing tension of the spring and along with this a tendency towards a decreasing absolute mean variation. With the weaker tensions the reactions were fairly mechanical; the reaction motion followed the stimulus without a conscious will impulse. With the higher tensions this was less the case, but whether with 1,000 grams, for example, each reaction motion was preceded by a deliberate impulse, or whether a general state, or 'set' of preparation for stronger impulses preceded the entire series, we do not yet know. In order to get mental conditions that were as far as possible constant, the introspections were reduced to a minimum. The tendency towards a smaller m. v. with the stronger tension indicates however, that the latter condition was the case.

To what is the increase in r. t. with increased tension due:— to the greater time required for the greater impulse or to the greater resistance to the movement of reaction? The indications from the table are that the latter is the case. The columns headed at^1, ap^1, at^2, ap^2, give the averages of the three quickest and the three slowest reaction-times respectively, together with the averages of the length (and strength) of pulls corresponding to these reactions. The table shows no agreement for any given resistance between length of reaction time and strength of pull[1]; of the 32 series tabulated, the quickest reactions give 16 longer and 14 shorter pulls than the slowest, while for 2 series within the limits of error of reading, the pulls are equal. In one of these series (10 reactions) the times ranged from 133 to 177 sigma, while the pulls were all of 1,775 grams; in the other, the time range was from 144 to 183,

[1]Curiously enough Ach (Willenstaetigkeit und Denken, S. 158) assumes that the opposite is true: *i. e.*, he regards it as "sicher" that the quicker reaction follows the stronger impulse.

TABLE II. TRIGGER-KEY

Reaction data of S for different tensions of spring

at¹ means average of ¼ of shortest reactions
at² means average of ¼ of longest reactions
ap¹ means average pulls for at¹
ap² means average pulls for at².

Grams tension	No. react.	Date	av. r. t.	m.v.	at¹	ap¹	at²	ap²	av. pull. m. m.
0 grams	11	Apr. 20	139	10	123	608	153	650	33
0 "	10	" 22	135	18	125	812	179	787	42
0 "	10	" 25	143	11	129	767	158	742	41
0 "	9	" 27	132	9	116	800	145	782	41
0 "	11	" 29	154	24	124	717	169	733	38
av.			141	14					39
100 grams	9	Apr. 20	146	7	133	875	154	862	35
200 "	11	" 22	139	10	127	908	155	925	38
200 "	9	" 25	176	9	135	887	187	900	36
200 "	10	" 27	145	16	124	908	169	975	39
200 "	10	" 29	159	7	149	825	172	833	33
200 "	11	" 18	149	14	125	883	167	871	35
av.			152	10					36
300 grams	20	Mch. 2	190	17	167	955	207	960	34
300 "	17	" 14	172	9	162	955	185	860	32
400 grams	20	Mch. 16	185	15	163	970	209	1075	33
400 "	25	" 21	176	14	153	1075	211	1050	35
500 grams	19	Apr. 8	154	26	124	1070	198	1110	31
600 grams	10	Apr. 11	162	15	139	1200	184	1225	32
600 "	10	" 18	153	5	143	1250	160	1242	33
600 "	11	" 20	145	13	135	1167	173	1133	29
600	8	" 22	153	24	128	1275	184	1287	34
600 "	10	" 25	176	9	162	1208	189	1200	32
600 "	10	" 27	139	7	129	1283	147	1312	36
600 "	10	" 29	157	11	129	1175	147	1175	30
av.			155	12					32
800 grams	18	Mch. 23	177	24	148	1388	215	1360	30
800 "	20	Apr. 13	138	14	116	1370	161	1395	31
800 "	20	" 15	162	12	144	1435	185	1425	33
av.			159	17					31
1000 grams	10	Apr. 18	159	12	141	1567	171	1583	30
1000 "	11	" 20	163	14	145	1542	188	1525	28
1000 "	10	" 22	176	18	146	1566	203	1533	29
1000 "	9	" 25	169	8	158	1600	186	1550	29
1000 "	10	" 27	163	8	149	1600	173	1600	30
1000 "	10	" 29	171	9	157	1567	184	1575	30
av.			167	10					29

with a uniform pull of 1,600 grams. There is therefore here no proportion between the reaction-time and strength of motor impulse for any given resistance. In addition, the m. v. show no increase with increase in resistance; indeed there is, for this reagent, a slight tendency towards a decrease of this quantity. If the observed increase in reaction time with increased tension were due to increased time in the discharge of the motor impulse, there would probably be an increase in the resulting m. v.

The last column in Table II gives in millimeters the average distance pulled for the several tensions. The length of the reacting scale for 2,000 grams of weight is 105 millimeters. Consequently the distance pulled may be found from the formula $d = .0525\,(l-t)$ where l is the strength of the pull and t the initial tension at which the index was set. For this table l is taken as the average of ap^1 and ap^2 which is very close to the average pull for any tension, and in some cases coincides with it. The table indicates a tendency to decrease the distance pulled with increase in initial tension t the falling off amounting to about one centimeter in going from 0 grams initial tension to 1,000 grams. We have accordingly with increased tension of pull an increased reaction time with a tendency towards smaller mean variation and a decrease in distance pulled. As this article is merely a preliminary survey of the field with one reagent, any attempt to evaluate the results would be premature. It is hoped that experiments with additional reagents supplementing those already performed, will show that the trigger key is helpful in the investigation of reaction processes.

PRECISION OF MEASUREMENTS APPLIED TO PSYCHOMETRIC FUNCTIONS

By F. H. Safford

In three closely related articles,[1] Dr. F. M. Urban has treated Psychometric Functions by the aid of statistical methods. For convenience these articles will be referred to as *I*, *II*, *III*, respectively. The object of this paper is to discuss his use of these methods from the standpoint of physical measurements only, and not to enter into the psychological questions involved.

In considering the results of physical measurements it is necessary to keep in view the precision of the observations, the extent to which deductions may be carried, and the methods of computation which will give the results without unnecessary labor. It is of course useless to expect good results from insufficient data, and equally useless to sacrifice good data by an incomplete analysis.

In order to be able to discuss the three articles intelligently it is desirable to refer to several fundamental principles of computation.

In most cases the term "precision" should be restricted to fractional precision, *i. e.*, the ratio of the error of a quantity to the entire quantity. When a result of a measurement of any kind is stated as 25,306, it is understood to show that the result lies between 25,305.5 and 25,306.5, or that the value is known with an error of not over one unit in the last digit. The fractional precision is this case is thus, approximately, one part in 25,000. Had the original result been 2,530,600. the fractional precision would have been the same. The two ciphers at the end are "insignificant" digits, serving only to indicate the position of the decimal point. The cipher between 3 and 6 is a significant digit, and the same is true of the ciphers in such a result as .12500. If the last two digits are

[1] I. The Application of Statistical Methods to the Problems of Psychophysics. The Psychological Clinic Press, Philadelphia, Pa., 1908.
II. Die psychophysischen Massmethoden als Grundlagen empirischer Messungen, Archiv f. d. ges. Psychologie, Vol. 15, Part 3 and 4, Leipzig, 1909.
III. Die psychophysischen Massmethoden als Grundlagen empirischer Messungen, Archiv f. d. ges. Psychologie, Vol. 16, Part 1 and 2, Leipzig, 1909.

written, they indicate, as before, that the result is between .124995 and .125005. When the result lies between .1245 and .1255 the correct form is .125. But in .0012500 the first ciphers are now "insignificant," serving as before to locate the decimal point. When a measurement is actually a counting of individuals, the last digit is not subject to an error in the sense used above. In general, the last digit of a measurement is liable to an error of one half-unit in that place, and to an average error of a quarter-unit. The precision of a measurement may be indicated for practical purposes by stating the number of significant digits, and it is not influenced by the position of the decimal point.

In the case of the four arithmetical processes the precision of the result is usually the same as that of the least precise element, a principle which may be deduced as follows. The product of .234 and 126.5 is 29.6010; but if the given numbers are measurements, they should be considered as $.234x$ and $126.5x$, where x indicates unknown digits. In adding the several partial products, each column containing an x must be rejected, leaving the result 29.6. This result is not as impressive as the former, but it is the only one justified by the data. The proof of the rule for division is similar. When a child is taught to annex ciphers to a dividend to facilitate division, he learns a rule which has no place in computation of physical measurements; and a division which is carried on after all the digits of the original dividend have been "brought down" presents a familiar exhibition of false accuracy. In addition and subtraction, the position of the decimal point affects the precision of the result, which is usually the precision of the numerically largest element, the use of an x at the end of each measured element affording a quick and reliable means of testing a result. When two elements in a subtraction are nearly equal, the result is often disappointingly inaccurate, so that an original precision of seven digits may be reduced even to one digit. Of course, logarithmic work is subject to similar criteria. The logarithm of 54.32 taken from a seven-place table may range from 1.7349198 to 1.7349997, so that 1.7349 or 1.7350 is as accurate as the given number will permit. If the given number were 54.32000, indicating a precision of seven digits, the seven place table would be properly chosen for use. Conversely, if the logarithm of a number is 2.34127, the number is anywhere from 219.4143 to 219.4194, *i. e.*, is correct to five digits only. Thus, in general, the number of places in the log. table should be that of the digits in the number. With few exceptions the precision of a result is not more than that of the data, and it is usually less.

It will be necessary later to employ the term average deviation of the mean. If the sum of n quantities is divided by n, the result is the arithmetic mean. The sum of the differences between the arithmetic mean and the quantities, taken without regard to sign, and divided by n, is the average deviation of a single observed quantity. If this deviation is divided by $\sqrt{n}$, the result is called the average deviation of the mean and gives a precision measure in common use by physicists. It is customary to compute this to two places of significant figures and then to retain in the arithmetic mean no digit beyond this second digit, since more than these are useless. The combined result is often written in the form $35.123 \pm .012$.

The experiments which were the basis of Dr. Urban's articles are described in *I*, page 1, and in *II*, page 261. A set of brass cylinders externally identical and of weights varying by four grams from 84 to 104 gms. was arranged at equidistant intervals determined by numbers from 1 to 14, around the circumference of a circular table. Standard weights of 100 gms. were placed at the odd numbers. The individual to be tested was requested to lift each weight in turn, and to give his judgment as to the relative weight of each cylinder at an even number and the standard cylinders at the preceding odd number. The table was rotated so as to bring the weights in succession under the hand of the observer, who stated his judgments at the rate of eleven and one-half per minute. Each experiment consisted of 50 comparisons of each weight with the standard, and the results of each experiment were separately tabulated, the judgments being classified as heavier, lighter or equal.

Seven observers were employed, of whom the first three performed nine experiments, and the others six. The "frequencies" for each of the three types of judgment were computed by dividing the total number of judgments of each type and for each weight by the total number of judgments in the nine or six experiments. Observer I° gave the judgment "equal" 28 times for the 84 gm. weight and 56 times for the 88 gm. weight. So that the two frequencies were $28 \div 450$ and $56 \div 450$ respectively. This process gave eventually a table of frequencies having seven entries, one for each weight. By interpolation, frequencies were found corresponding to weights varying by single grams from 84 to 108, but only the seven original entries were experimental results. After the plotting of these extended results for each observer and for each type of judgment, smooth curves were drawn through the twenty-five points of each plot. The curves for equality judgments were somewhat like the ordinary probability curve, while those

for lighter and heavier judgments were low and high respectively at the right ends and *vice versa* at the left ends.

The equality curve for observer I° was treated most elaborately and so will require the most attention in this paper. The original frequencies for observer I° (*I*, table 85) were:

.0622, .1244, .3311, .4422, .4644, .0911, .0533.

The number 28 above mentioned, which is the total for nine experiments, is the sum of widely varying components, viz., 4, 3, 4, 4, 2, 5, 2, 3, 1. If we follow the procedure previously explained and compute the average deviation of the mean, these values give 3.11 ± .34. In this manner the original frequencies revised and with useless digits omitted are:

.0622 ± .0067, .124 ± .019, .331 ± .045, .442 ± .025.

.464 ± .045, .0911 ± .0061. .0533 ± .0099.

Thus a three place log. table is sufficiently accurate for the computation, though it must not be inferred that this means rough approximation; for, on the scale adopted by Dr. Urban, a change of a unit in the third decimal place of an ordinate is not visible to the naked eye. Granting the use of these ordinates to four digits and no further, it should be observed that these ordinates and the corresponding abscissae 84, 88, etc., give seven points and no more for the purpose of defining the psychometric curve of this observer.

At *I*, page 126, Dr. Urban proceeded by the use of Lagrange's formula to obtain the equation of this curve in Cartesian co-ordinates, since in that form the result is easily differentiated, thus enabling one to locate the maximum ordinate. In this computation the seven ordinates were treated as if exact to any desired extent, *i. e.*, in the divisions, zeros were added to the dividends giving some quotients to twenty-four significant figures. Such precision is equivalent to stating the volume of the earth with an error of not over one cubic inch. On an inserted sheet (*I*, p. 129), giving only a portion of the details, there are over fifteen hundred digits, and but for two accidents the equation of the psychometric curve would have coefficients correct to eighteen digits. One accident is that certain of the results are computed to only eleven digits; the other is an error in the computation of $a,\phi(x)\colon (x-84)\ m_1$, where the coefficient of X^4 is given as .0030354220980 13889, when it should be .0030354220920 13889. This error gives the ordinate of the point for which X=100 the value .4650 instead of .4644 as in the data. Newton's method of differences gives a formula which is theoretically the same as that by Lagrange, and requires about one-tenth of the labor. While this is not in a form for easy differentiation, the method of approximation will quickly locate the maximum ordinate, giving its location far closer than the data will warrant.

Certain theoretical topics about this curve must now be treated. In *I*, page 139, this statement occurs. "Interpolation by Lagrange's formula has not the character of a definite hypothesis on the nature of the psychometric function but it is rather a method of completing a set of observations." Lagrange's formula gives the equation of a curve through n points, whose degree is not greater than n and the n points determine the curve completely. In fact, for any set of n points only one curve exists of the type which Lagrange's formula assumes. The use of Lagrange's formula certainly makes a definite assumption about the type of the psychometric function, which is all the more open to objection because all of the probability curves, both symmetrical and asymmetrical, are definitely excluded. An infinity of curves of the same general form, if desired, but of higher degree may be made to pass through any n points, so that it seems utterly useless to spend energy in locating within one one-thousandth of an inch the maximum point of a curve whose only claim for consideration is the fact that its equation is simpler than that of other curves. Circles were once considered the only perfect curves; hence it was argued that heavenly bodies must have circular orbits. As a last comment on the quotation above, if Lagrange's formula enables one to complete a set of observations, why not make fewer observations and use the formula instead? Thus from two observations one could obtain an indefinite number of new "observations," but unfortunately all would lie on a straight line through the two original points.

Without detracting from the very able mathematical treatment of the theoretical psychometric curves, it is important to notice that the observation curves in *I* and *II* show such divergence from the theoretical curves in *III* that deductions from the latter are not applicable to the former. But the former are not a necessary conclusion from the seven points. From a mathematical standpoint it is desirable to have more points for the curves, and these must not be obtained by any formula of interpolation, since this process introduces an assumption about the curves, in fact is equivalent to defining the curves completely. Under the conditions provided in these experiments the deductions may quite as well be obtained from the plots themselves, since the observations are not sufficiently precise to justify such exhaustive mathematical treatment.

THE PSYCHOLOGY OF DROWSINESS

An Introspective and Analytical Study

By H. L. Hollingworth, Barnard College, Columbia University

The investigation of sleep and dreams seems to the writer to have neglected to explore in an adequate way a region of normal conscious life which merits more attention. This region is the state of drowsiness, which usually precedes the sleep state, and which is especially prominent and long drawn out in conditions of over work or unduly protracted waking hours. Much, of course, is known of the dreamy mental states so clearly described by Crichton-Brown[1] and intimately related to the auræ which frequently precede epileptic seizures, and of the various disturbances of sensation and perception in neuraesthenia, psychaesthenia and the many pronounced types of alienation.[2] Something is known of the variously named hypnoid, hypnagogic or pre-sleeping state which is often found to precede the hypnotic trance, and of the dissociations found in hysteria. The "dreamy mental states" described by Crichton-Brown in his Cavendish lecture were such experiences as "double consciousness—loss of personal identity—a going back to childhood—vivid return of an old dream—losing touch with the world—deprivation of corporeal substance—loss of sense of proportion,—momentary black despair—being at the Day of Judgment," etc. And they are asserted to be "abnormal in their essence and morbid in their tendencies."

But references are few in the literature to the suggestive and quite common hallucinations and perceptual complications experienced by supposedly normal people in the state of drowsiness, and such search as the writer has been able to make has disclosed no careful description or analysis of this state. Prince[3] has recently asserted that the pre-sleeping state has "certain marked characteristics which distinguish it from the alert state of waking life and is worthy of study in itself." M. Maury[4] in the report of his experiments on dream

[1]Dreamy Mental States—The Lancet, July 6, 13, 1895; Nos. 3749-50.
[2]Paton: Psychiatry, pp. 26-127.
[3]Mechanism and Interpretation of Dreams. Jour. Ab. Psy., 1910, p. 139.
[4]Le Sommeil et les Rèves. p. 42, etc.

production describes the so-called "hypnagogic hallucination" which he regarded as constituting "the chaos out of which the dream cosmos is evolved," and Herschel[1] has described "sensorial visions" which occur during the waking state, but these seem to be merely the familiar entoptic phenomena of waking life. Sully[2] calls attention to the presence of transition states between sleeping and waking and to the comparative ease with which sense illusions occur in these states. These seem to be the "hypnagogic states" of Maury, "states of somnolence or sleepiness in which external impressions cease to act, the internal attention is relaxed, and the wierd imagery of sleep begins to unfold itself." But Sully's chief emphasis is on the persistence of the dream hallucination proper into the postsomnial condition.

Conceivably the state of drowsiness might throw considerable light on dream formation, the relation between the latent and the manifest content of dreams, and the various ways in which external impressions and central dispositions are transformed and related in the serial dream. Drowsiness is the transition state between waking consciousness and dream life, and careful observation of this state should be able to catch dreams in the making and to disclose the tendencies which attain their maximal operation in the sleep state proper. Whether or not it be true that the genuine dream is experienced only in moments of awaking from or falling into the sleep state is immaterial. The dream as a more or less systematic articulation and fabrication is quite distinguishable from the unique fusions which come in moments of drowsiness. In the experience of the writer and his observers these latter are more often momentary perceptual states, flashlights of imagery of unwonted vividness which may as such be repeated in successive moments but which do not tend to lead on to new situations as do dream states. And yet these perceptual fusions show striking points of similiarity in their composition to the various units of the serial dream.

The purpose of this paper is to describe several typical cases of the drowsiness hallucination and to analyze out some of the principles which clearly contribute to their formation. Two observers, the writer (H) and his wife (L), have for the last two years been recording these experiences, with the result that an accumulation of cases has been acquired which seem to show sufficiently pronounced characteristics and similiarities to make their discussion worth while. The observations have invariably been made in the pre-sleeping

[1] "On Sensorial Visions" in Popular Lectures on Scientific Subjects.
[2] Illusions, p. 184.

state, for neither of the observers has the drowsiness hallucination in any marked degree in the pre-waking state. In all cases the observer has been aware of the hallucinatory character of the experience, and has immediately written out the description or narrated it to the other observer.

The imagery type of the observer, as will be shown later, seems to be to some extent, a determining factor in the composition of the hallucination content, in that modes which are only vague and seldom used in the waking state become vivid and active in the drowsy condition, while the type modes fall into the background. It will then be of interest to know that according to frequent imagery tests L is predominately visual and visual-verbal in type with almost no auditory or motor tendencies, while H is very highly auditor-motor, both as to imagery and memory type, has frequently had auditory and motor hallucinations, especially marked in childhood, but is a very poor visualizer. Typical cases are given in the following paragraphs, and in the subsequent analysis these cases will be referred to by number.

Case I. Observer H. On board ocean-liner, dressing for dinner in suit purchased abroad, sitting drowsily on edge of berth and thinking that the suit had turned out to be a bad investment and had been forced on to me by a tricky salesman. Planning to buy cloth this time to be made up in United States and wondering if it would pass Customs. Suddenly the rush of water heard through the porthole becomes transformed into the husky voice of a salesman trying to sell me a suit. I fall to musing in the process, wondering, while he talks, at his husky voice and why he has no more inflection.

Case II. Observer H. At Victor Herbert's opening concert, 1909, L—, E—, and myself were talking of the cartoons of Mr. Bug in "Life." L— described a cartoon in which the six legs of Deacon Fire-fly were represented as grasping different objects such as a Bible, a prayer book, etc., while Mr. Bug held playing cards, a bottle, a cigar, etc. I had been working all day on comparative nervous anatomy, preparing a lecture on complications of stimulus and response, and had my head full of segments and nervous arcs. The orchestra played Grieg's "Wedding Day at Hegstad." In the last bar there were three finishing blasts with full orchestra. I had become very drowsy and these blasts seemed to me to be movements of some huge bug which came sailing from behind the wings, suddenly alighting on the stage, first on the two hind feet, then bringing down the middle pair, and finally the two front feet with the final blast. The visual elements present were of huge, vague, rather reddish brown jointed legs, the feet not clear and only the lower ventral side

of the body dimly suggested, but flashing out at each "land" of the feet.

Case III. Observer H. In bed, winter '09, with "grippe." Kept tossing from side to back, then to other side. As I tossed the numbers 50, 2, 36 kept running in my head, appearing clearly visually as 5236, and auditorially as "fifty two— thirty six." Now these (50, 2, 36) were the combination numbers of my gym locker, which I opened by turning the knob left-right-left-right, four turns, very much as I now tossed in bed. In my tossing the numbers rang and rang in my head, the left side seeming 52, the right side 36, the back 5236. It seemed that if I could juggle these numbers into the right combination I could find a comfortable position.

Case IV. Observer L. Tossing experience similar to above, but seemed to be going to Brooklyn and back, Mrs. M.— who lives there having lately been uppermost in mind through conversation, letters and a recent visit.

Case V. Observer H. Played checkers nearly all day on steamer. Retiring to cabin before sleeping time, threw myself drowsily on my bunk and fell to ruminating over some projected experiments on the comic, wondering whether to follow method of order of merit or that of assigning numerical grade to each comic situation. I decide, but in my half awake consciousness the decision takes the form of a move in checkers. I decide to move my white man up to the king row and mentally see C— jump it with his black.

Case VI. Observer H. Lying in bed talking. In a pause I see a large marble toad-stool which seems to stand on a hill and to resemble the dome of the New York University Library, around which runs the Hall of Fame. On top of the toad-stool bell were stamped in large black letters, three names, "Jastrow," "Gillis," and another blurred one which I could not make out. At once I told my companion of the vision, saying "I see a curious hall of fame," etc. That evening I had read some comments on Jastrow's magazine article on" Malicious Animal Magnetism" and had also seen in a comic paper a picture called "The Annual Ball of the Mushrooms." Psycho-analysis threw no light on the name "Gillis" nor on the blurred name.

Case VII. Observer L. Had a bad toothache, and though very sleepy and worn out could not sink into a sound slumber because of the pain. For several hours I lay in a state of semi-consciousness, tossing from side to side in a drowsy effort to find a comfortable position. All day I had been very intently working on a coat which I was making, and my tossings back and forth were all in terms of the seams on the coat, *i. e.*, as I turned to the right the seam down the

right side of the garment was inspected, then as that position gradually grew unbearable the seam began to wrinkle, to pucker, and to become quite unmanageable. Thereupon I decided to work awhile on the other seam, and turned to the left side and carefully basted and pressed the seam on the left side of the coat. But, though it behaved very satisfactorily for a time, it too, soon began to wrinkle and the thread to snarl. In despair I attacked the seam on the right side again, that is, I turned over to my right side once more. This continued for an indefinite time. I was in despair. I feared the garment would be quite ruined. All through these hours I was conscious of the slight flapping of the window blind and twice I replied quite sensibly to the questions of my companion, and noted the striking of the hours on a clock in another apartment. But the illusion that I was wrestling with the seams of a refractory garment was not dispelled till I fell asleep at daylight.

Case VIII. Conversations during the drowsy state.

(a) L— Let's hurry and get there by ten o'clock.

H— That's easy. I could get there by a nickel to ten. (It was then 9.50)

(b) H— (As L rises from the sofa where she has been resting and leaves the room) So you want some water, huh?

L—(Entering again) What did you ask about a drink?

H—Nothing.

L—But you asked me something about water.

H—(drowsily) It was n't an asker, it was just a sayer.

(c) H is said to behave when drowsy much like a child or like a half-intoxicated man,—thus: he approaches an old pillow spotted with ink blots and asserts in a child-like way quite without provocation or connection,—"Red ink! black ink!" pointing to the spots meanwhile.

(d) L asks question to which H replies, quite without relevance, "I don't think you could see the manuscript."

(e) L— "How curious the moon looks behind the clouds!"

H—Yes, just like a thin place in the sky."

Case IX. The writer has frequently recorded fantastic experiments and conclusions developed either alone or during discussions, late at night. At the time of their conception all of these plans and insights seemed highly rational, strikingly original and wonderfully significant, and the observer has usually marvelled that nobody had ever seen the thing so clearly before. He has frequently gone ahead after the midnight hours and prepared the material for one of the revolutionary experiments or demonstrations just conceived. But when the plan or conclusion has been gone over on the following morning the most striking thing about it has been its splendor

as a work of unbridled imagination, but its absurdity as a scientific achievement. The argument is found to abound with fallacies or the experimental procedure with sources of error that were lightly bridged over the night before. The experience is no doubt a very common one. It seems much like the nocturnal aereonautic inspection of a line of march which must be gone over on foot when daylight comes.

Case X. The reason for citing the two following literary references will be seen later. They are typical drowsiness figures.

(a) This passage from Stevenson's letters to Henry James (Stevenson, Letters, p. 435) must have been written late at night and in a state of drowsiness. In fact Stevenson says earlier in the letter "my wife being at a concert and a story being done," indicating a late hour, and (especially in Stevenson's case) fatigue. Speaking of the "Henry James chair" the writer of the letter says, "It has been consecrated to guests by your approval and now stands at my elbow gaping. We have a new room, too, to introduce to you—our last baby, the drawing room; it never cries and has cut its teeth. Likewise there is a cat now."

(b) De Balzac, who wrote the following passage must have been a night worker,—"He saw his teeth departing one by one like brilliantly dressed ladies from a ball room."

The experiences here recorded can hardly be classed as dream states though it is true that only a little elaboration would be needed to make them develop into such states. They all occurred during waking moments, and frequently (See Cases 2, 5, 7) there is clear evidence that the observer is actively engaged in some waking employment or lively thought process or is conscious of external events. Yet most of them are hallucinatory in character. Examination of such cases as those given above reveals several rather clearly defined principles of composition or general tendency. Chief among these are the following, the exposition of which seems to constitute a fairly true, though perhaps, only partially complete analysis of the state of drowsiness. Other experiences of much the same kind could be given, some of which are withheld only because of their close personal character, but all point in the same direction as the cases here given, some of them even more definitely.

1. Transformation of Imagery Type

Modes ordinarily vague and feeble become here dominant and vivid, even tending to replace customary imagery habits. Thus H, who is predominantly auditory and motor in type and can only with difficulty summon up visual images of even

the most moderate vividness, has, in the drowsy state, visual experiences which constantly amaze him by their clearness. (See Cases 2, 3, 5, 6.) L, to whom sharp visual imagery is a common habit, but who, in her waking consciousness cannot understand what kinesthetic imagery is like, tends, in the drowsy state, to relive motor experiences almost exclusively. (See Cases 4 and 7). Along with this emphasis of unusual modes goes the subordination of dominant modes, so that in the drowsy state as in dream life, images even of these unusual types seem to exceed by far in intensity the clearest images of the waking state.

It seems to be generally true that with increased age, increased book learning and, in general, with practice in verbal modes of thinking, sense imagery gives way to word imagery of one kind and another.[1] Parallelling this fact, many people have complained to the writer that with maturity they lose their long drawn out delight in books, and especially in descriptive literature. They tend more and more merely to scan such passages and hence to read books much more quickly. They may regret the loss of the old source of satisfaction, the character of which they do not understand. Evidently what happens is that sense imagery is waning and description no longer has its old power of awakening interest or calling forth emotion. In drowsiness this state tends to disappear. The dominant modes in which one has become accustomed to think in the more rigorous sense, seem to tend toward sleep more quickly, while the lower, more strictly sensory centres remain active or go to sleep more slowly.

(*Note.* Since the preceding paragraph was written the writer, in re-reading Professor Titchener's striking analysis[2] of his own imagery processes, has found what seems to be another clear instance of the transformation of imagery type. Although this observer says it is possible for him to "trust to the guidance of kinæsthesis," this mode of imagery does not seem to predominate in his daily life. The following statements show the apparent superiority of his visual and auditory imagery. "I rely in my thinking upon visual imagery . . . " etc. "My visual imagery, voluntarily aroused, is extremely vivid." ". . . visual imagery which is always at my disposal and which I can mould and direct at will." But he also has "vivid and persistent auditory imagery" and never sits down to work without a "musical accompaniment." Kinæsthesis seems to play a rather sub-

[1]Galton: Inquiries into Human Faculty, p. 60.
[2]Experimental Study of the Thought Processes, 1909, p. 9.

ordinate rôle, although we do find the remark, "As a rule I look to all three kinds of prompting in the course of a single hour." But, and this is the interesting point in the present connection, ". . . *when I am tired* (italics mine) I find that vision and audition are likely to lapse, and I am left alone with kinæsthesis.")

In this state the condition of early childhood is reproduced and sense imagery may become vivid, intense and grotesque. This tendency, along with the absence of sensory stimulation probably accounts as well for the greater vividness of images in dreams. The frequency and character of dream imagery has sometimes been taken as an index of the type habits of waking life, but the transformation tendency shown in the observations here presented seems to show clearly that this is not the case on the state of drowsiness. The difference may, perhaps, be explained by supposing that in sleep all the centres are more nearly equally quiescent, while in drowsiness the type centres slumber first, thus giving prominence to modes not usually relied on.

2. Substitution

Within the content of the drowsiness fusion it will be seen that a present impression, a preservative tendency or, perhaps, even a pure memory element often substitutes itself for some other datum whose rôle it fills in the perceived composition of the hallucination. Illustrations of these forms of substitution are afforded by the cases here reported.

(a) Sensory Substitution. Here a present sensory impression takes upon itself the task of impersonating more ideal or memory contents, of bearing their qualities, carrying out their behavior and in a general way acting for them. Thus in Case I the sound of the waves washing against the sides of the boat assumes the rôle of the foreign salesman, becomes his voice and seems to constitute his conversation. In Cases 3, 4, and 7 present motor processes (tossings, turnings and other changes of position) become the vehicle on which are borne memory experiences of a day or two before.

(b) Perseverative Substitution. Case V in which the thinking out of the technique of an experimental problem seemed to be carried on in terms of the manipulation of the white men on a checker board, affords an excellent illustration of the tendency of perseverative impressions to play the rôle of other data.

(c) Ideal Substitution,—in which an ordinarily revived image becomes the substantive for experiences more or less remote or assists in the interpretation of a present impression is rather difficult to demonstrate for two reasons. In the first

place it is not easy to draw the line between perseverative impressions and supposedly revived images. Thus in Case I the huge bug which was conceived as alighting on the platform in order to apperceive the three successive orchestra blasts, was evidently a pure object of "creative imagination," for no previous impression had corresponded to a creature of such dimensions. Yet the character of this imagery content was probably determined by certain perseverative tendencies arising from the prolonged consideration of the various types of nervous anatomy. In the second place, substitutions of the sensory and perseverative type usually involve a correlative displacement of the ideal content for which they act, and in setting up ideal substitution as a third type, on the basis of the data at hand, one is perhaps, merely paraphrasing what he has already said.

At any rate it is clear that interchange of ideal with both sensory and perseverative content and interchange of sensory with perseverative content occurs. Whether one pure ideal datum may act as substitute for another, future observation may show. DeBalzac's simile (x, b) which sounds much like the conversation of a drowsy man, seems to be a case of such substitution. More will be said of such literary figures in the following paragraphs.

3. Fluid Association on a Sensory Basis

with removal of constraining mental sets and controls. This leads to bizarre analogies, naïve statements and unusual verbal combinations. In this respect the state of drowsiness seems to be quite like genuine dream consciousness, in which such free association tendencies are so pronounced. Thus De Manacéine[1] points out "the tendency which compels us during sleep and during enfeebled states of consciousness generally to associate everything which presents some common resemblance, for example —words according to their sound, and images according to some accidental and external resemblance. The same tendency is observed in the uneducated and very markedly in the insane. . . Any resemblance in color or form is enough to associate images which are altogether (1) heterogeneous." Again, "There is a well known tendency in dreams for the perpetration of bad puns, sound leading sense, as happens frequently with the insane, idiots and young children." Prince[2] in referring incidentally to the characteristics of the pre-sleeping state has written, "ideas course through the mind in what appears to be a disconnected fashion, although probably determined by associations.

[1]Sleep, p. 283 ff. [2]*Op. cit.*

Memories of the preceding day and of past thoughts which express the interests, desires, fears and anxieties of the psychological life and attitudes of the individual float in a stream through the mind like a phantasmagoria."

Examples a, b, c, d, and e under CaseVIII afford concrete illustrations of such uncontrolled accidental association. Formal, practical and conceptual constraints being removed, resemblances of a sensory and ordinarily unnoticed kind, which seem to involve only lower nervous centres become predominant, verbal plays (b), naïve confusion of related concepts (a), absurd juxtapositions (d) and attention to irrelevant details (c) abound in the state of drowsiness. Not infrequently similes and affective chords are hit upon which with only a little treatment would become adequate literary figures (e).

Indeed, many of the choicest paragraphs to be found in the works of imaginative writers bear all the birth marks of a drowsiness conception. The illustration from Stevenson's letters (10a) is clearly a case of unusually vivid imagery, sensory substitution and uncontrolled association. In this connection Marsh's study[1] of the favorite work hours of 160 eminent writers is extremely interesting. Some of Marsh's conclusions are as follows:

"If the poets and novelists are roughly designated as an imaginative class and the historians, clergymen, essayists, critics, journalists, philosophers, etc., as a broader intellective class we shall find the former predominant in the morning and night groups and the latter in the day ones;" ". . . of the after midnight workers all are of the imaginative type;" ". . . excitation of some sort is most often the precondition of the highest imaginative work." ". . . numerous and well-patronized methods of mental stimulation—from ordinary walking, riding or music to hourly service of blackest coffee, greenest tea or strongest opium or to constant use of tobacco, before and during composition. The extensiveness of this practice among the imaginative writers is striking."

One might mention in the same connection the fact that Mark Twain is said to have done most of his writing in bed, if not while actually sleepy at least in the sleeping posture, and the further fact that certain favorite poets have produced nothing of note since they were induced to sign the temperance pledge. The use of drugs and the preference for night hours both point in the same direction. It seems to have been shown plainly that the apparent stimulating effect

[1]Diurnal Course of Efficiency, Archives of Psychol. No. 7, 1906, pp. 59-69.

of such drugs as are used depends on the fact that they narcotize the higher centres, on the functioning of which depend our control processes and constraining mental sets. And much the same condition seems to be the cause both of the involved serial dream states and of the vivid perceptual drowsiness complications. The similarity of these states to the oft described alienation psychoses will at once remind the reader of Nordau's fervent chapter[1] on Mysticism.

The artist and the poet must in some way get out of the world of percepts and into the world of pure sensory qualities. And this is not an easy thing for most of us to do. Most of us were there when we were children and the most prosaic of us tend to slip over the frontier in the pre-sleeping state or when under the influence of artificially induced drowsiness. A very few of us are vagabonds enough to be able to wander back and forth at will, and these are the artists and poets.

4. Isolation of Association Trains

This characteristic of drowsy states is closely related to that described in the foregoing section. The difference lies in the fact that there we were dealing with single perceptual or ideational contents while here we have to do with such serial chains of associations as may sometimes be set up. In the drowsy state proper, in the experience of the writer, these chains do not develop,—the genuine drowsiness complication being either a simple "flashlight" hallucination or else a sort of "boomerang" composition, tending to return always upon itself rather than to lead on to further and new associations. But such experiences as those described under Case IX seem to belong to much the same state. These fantastic thought systems evolve most easily in times of fatigue, loss of sleep or unduly prolonged intellectual work. When the drowsy state is thus extended over a long period of time, association chains and reasoning show much the same behavior that perceptual or ideational states do in the drowsiness state proper. The essential thing is the release of all intellectual inhibition. An idea, plan or desire is thus able to make unimpeded progress from stage to stage of its development with what seems at the time to be unerring logic. Its evolution is accompanied by the strong emotion and the feelings of exuberance, bouyancy, confidence and eager enthusiasm characteristic of the night worker. In my own case the feverish plans, insights and conclusions developed in midnight hours have almost invariably faded into pale grays on the arrival of the next "waking consciousness"

[1] Degeneration, Ch. I.

much as did Maeterlinck's "Bluebird" when brought into the sunlight.

The drowsiness thought process behaves much as do the familiar dream states in which cosmic riddles are solved and impossible mechanical devices evolved. One recalls in this connection the oft-told case cited by Crichton-Brown of the man who determined to write out the solution arrived at in order to preserve it from the amnesia which usually developed on awaking. When morning came he looked eagerly for the paper on which he had written during the night and read there only the single mystic sentence, "A strong smell of turpentine pervades the whole."

Rivers and Weber[1] have shown that mental fatigue, anæsthetization of the muscle involved, or small doses of alcohol may have the same effect, viz.: a momentary falling off of fatigue due to disregard of secondary afferent impulses which are the basis of the fatigue feeling. Much the same situation seems to be present in the drowsy state and the disregard of obstacles and treacherous points in the chain of reasoning is probably due to quiescence of the higher centres which control both motor output and processes of inference. Such a condition is reconcilable with any of the current theories of sleep and with most theories of epilepsy, to the intellectual auræ of which the drowsiness hallucinations seem to bear a close resemblance.

5. Grandeur and Vastness

Closely connected with the transformation of imagery type and the isolation of association chains is the tendency toward grandeur and vastness which usually characterizes the drowsy states. This is true of the simpler perceptual complications as well as of the further developed thought processes. Thus in Case II the idea of a gigantic insect, and in Cases 3, 4, and 7, the interpretation of limited motor processes in terms of long journeys or of complicated activities such as dress-making and opening combination locks, and in Case I the personification of monotonous noises, show the tendency to magnify simply sensory impressions. In another case, not recorded here, a space of perhaps three feet was taken to represent the ocean.

When a chain of reasoning is involved, all projects are fertile and all outcomes expansive. The common tendency for the disagreeable, the undesirable and the unfavorable fact to oblivesce seems here to be especially strong. The drowsiness experience, in the case of the present observers at least,

[1]On the Effect of Small Doses of Alcohol. British Journal of Psychology, Jan., 1908.

resembles that following upon the inhalation of diluted nitrous oxide gas,—"the mental symptoms consist in convictions of emancipation, relief and happiness, in grand and sublime ideas which in their expansion seem to break down all barriers of doubt and difficulty and to make a wish and its realization one. . . . . It is at the point where the habitual control or check of the highest centres is withdrawn and where subordinate centres are free to indulge in unwonted activity that the expansive dreamy thoughts and exalted feelings present themselves in the progress of nitrous oxide gas intoxication."[1]

6. Amnesia for Processes and Events

occurring during the drowsy state comes quickly. This is shown by the tendencies of these experiences to escape observation unless special interest directs attention to them. Further, unless they are recorded or reported promptly they are soon forgotten or elaborated by the retrospective attempts of waking consciousness.

7. Absence of Symbolism

So far as the writer has been able to discover there is no evidence of special symbolism in these states except in so far as they reflect the recent experiences or occupations of the individual. The composition of their content seems to consist chiefly in "flashlight" perceptual complications of the memories of recent experiences with perseverative tendencies and present sensory impressions. Only in so far as the data from these three sources is somewhat dependent on the fundamental interests of the observer can the drowsiness psychosis be said to be symbolical.

(*Note*). Sidis (Experimental Study of Sleep) has given "extreme suggestibility" as one mark of the hypnoidal state. This state bears a close resemblance to the condition of normal drowsiness, and may, perhaps, be identical with it. But suggestibility seems to be a general statement of the possibilities of the pre-sleeping state, rather than an introspective description of the drowsiness consciousness.)

By way of summary we may say, finally, that the drowsiness hallucination seems to be a "flashlight" perceptual fusion or complication, and is further characterized by transformation of imagery type; sensory, perseverative and ideal substitution; fluid association chiefly on a sensory basis; and by isolation of association trains when they develop; and that it is accompanied by tendencies toward grandeur and vastness, by rapidly developed amnesia and by absence of symbolism.

[1]Crichton-Brown: *op. cit.*

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF VASSAR COLLEGE

XIV. An Effect of Fatigue on Judgments of the Affective Value of Colors

By Ethel L. Norris, Alice G. Twiss, and M. F. Washburn

A state of fatigue may naturally be expected to lessen the pleasantness of pleasant experiences and to increase the unpleasantness of unpleasant experiences. The present study is an attempt to get experimental confirmation, within a certain very limited sphere, of this conclusion drawn from general experience. As the source of pleasant and unpleasant affection we chose colored papers. With regard to the source of fatigue, evidently a number of possibilities were open: we might have used some form of physical fatigue, but we chose mental fatigue instead. Here, again, we might have produced fatigue in our observers by means of some kind of mental work, such as mental arithmetic, quite different from the work of judging the affective values of colors. We undertook, however, the problem of finding how far judgments of the affective value of colors are influenced when the observer is required to perform a long series of such judgments. That is, the fatigue was produced by the same kind of mental process as that upon which it was supposed to act.

Our method was as follows: A piece 2.9 cm. square was cut from each of the ninety colored papers in the Bradley series, comprising eighteen saturated colors, namely, red violet, violet, blue violet, violet blue, blue, green blue, blue green, green, yellow green, green yellow, yellow, orange yellow, yellow orange, orange, red orange, orange red, red, violet red; together with two shades and two tints of each color. Each piece of paper was placed on a white background before the observer, who was required to look at it for ten seconds and to record her judgment of its affective value in numerical terms, using the numbers from 1 to 7 to designate respectively the following degrees: very unpleasant, moderately unpleasant, slightly unpleasant, indifferent, slightly pleasant, moderately pleasant, very pleasant. The colors were shown in wholly irregular order. After judgment had been passed upon the whole ninety, without any pause in the operations the observer was given in succession the first six colors of the experimental series, in their original order, and required to record anew her judgment of their pleasantness or unpleasantness. In no case did the observer report remembering what her previous judgment had been. The whole proceeding took from three-quarters of an hour to an hour. The effect of fatigue upon the affective tone of the six colors selected to begin the series was then calculated as follows. When the number assigned to a color at the end of the series differed from the number assigned to the same color at the beginning, the amount of the difference together with its sign, *i. e.*, whether it was an increase or a decrease, was noted, and these differences were averaged, regard being paid to signs. Thus for one observer the affective value of one of the six colors dropped two numbers, that of another color dropped one number, that of a third rose one number, and that of three colors showed no change. The total change for all the colors tested was then 1—3, or—2; and dividing this number by 6, the number of colors tested, we find the average fall in affective value to be .3.

There were thirty-five observers, all women and all but four college students. Out of these, the averages of seven showed a rise instead of a fall in the affective value of the colors at the end of the series, and for three the affective values were exactly the same at the beginning and at the end. Twenty-three observers show an average drop of from .1 to 1.5. In the case of three observers every change in the affective value of a color was an increase: in the case of ten, every change was a decrease.

It is unnecessary to point out that we cannot be sure of producing uniform degrees of fatigue by this method. Aside from individual differences in physical condition and previous fatigue, the process of judging required is undoubtedly more fatiguing to some people than to others. Thus one of the three observers for whom the affective values were greater at the end than at the beginning of the series was an artist, to whom the colors had probably more interest than to the other observers. Again, in the case of those observers who were acquainted with the method the knowledge that the end of the series was approaching produced a cheering up which might have been expected to counterbalance fatigue; although this did not prove to be the case with two out of the three authors of this study. When a drop in the affective value of a color does appear at the end of the series, we have no assurance that it is produced by fatigue; but since the other sources of variation might be expected to produce a rise as often as a drop, the results do indicate that *for sixty-five per cent. of our observers fatigue was the prevailing source of change.*

Two further facts may be noted. The total number of points by which the saturated colors were raised in affective value at the end of the series was 29; the total number of points by which they were lowered was 35; the excess of lowering over raising is then only 6. The corresponding excess for tints is 31, and for shades, 40. Shades, tints, and saturated colors were selected with about equal frequency for use as the test colors at the beginning and end of the experimental series. These results, then, seem to mean that *under the experimental conditions described, the effect of fatigue in lowering affective value is very decidedly less marked in the case of saturated colors than in that of shades and tints.* On the other hand, the variations from other sources than fatigue seemed to influence saturated colors, shades, and tints to nearly the same degree, if we may judge from the fact that the percentage of cases where the affective value of a color was the same at the beginning as at the end of a series was, for saturated colors, 40; for tints, 34, and for shades, 45. It looks, however, as though the affective impression made by saturated colors, whether pleasant or unpleasant, were so definite that fatigue induced by this method alters it but little; although we might expect that *continuous* experience with a saturated color would cause a rapid drop in its pleasantness.

Secondly, we undertook to find what kind of judgments were most influenced by fatigue. When we counted the number of times each numerical judgment from 2 to 7 appeared in connection with the first six colors of the series, and found in what percentage of this number the judgments were lowered at the end of the series, there appeared to be no uniform relation between the degree of pleasantness or unpleasantness in the first experience and the amount of lowering of affective value in the second. We noted that other sources of variation appeared to affect extreme judgments, 1 and 7, more than moderate judgments: the percentage of cases involving no change whatever in affective value was highest for the judgments 7 and 1. We at first thought that this result pointed to a conclusion regarding the variability of a given individual's affective reaction to a given color, which might be expressed in some such terms as that we are less likely to change our minds with regard to the objects of our extreme likes and dislikes than with regard to those which produce more moderate affective reactions. But later reflection showed us that the real cause of

the fact that the extreme judgments appeared to be more constant than the moderate ones lay in the conditions of the experiment. If the first judgment upon a color has been a moderate one, there are three possibilities with regard to the second: it may express the same affective value as the first, or a greater affective value, or a less one. If on the other hand the first judgment has assigned either the highest or the lowest affective value to a color, there are only two possibilities with regard to the second judgment: it may be the same as the first, or it may vary from it in one direction only. It naturally follows that the percentage of cases showing no change will, if there is no constant tendency present, be greater where the first judgment has assigned the highest or the lowest affective values.

XV. A Note on the Affective Values of Colors

By M. F. Washburn

In the preceding study each of thirty-five observers was required to record in numerical terms her judgment on the pleasantness or unpleasantness of ninety colors, each color being presented in the form of a paper square 2.9 cm. a side, on a white background, and looked at for ten seconds. From the results thus obtained the verdicts of the different observers on a given color have been selected out, and their average calculated together with the mean variation. The whole series contained ninety saturated colors besides two tints and two shades of each color. To avoid what seemed unnecessary labor, the calculations to be discussed were made only for the lighter tint and the darker shade of each color: thus for eighteen tints and eighteen shades.

It appears that for our thirty-five observers, all women and nearly all college students, *the affective value of the tints is highest* (average from all observers, 4.7); *that of the shades is next* (average from all observers, 4.1), *and that of the saturated colors is lowest* (average from all observers, 3.6). Further, that *the affective reaction to saturated colors*, whether pleasant or unpleasant, *is more positive than that to shades and tints, and that to tints more positive than that to shades*, is indicated by the fact that the total number of judgments '4' (indifferent) is for saturated colors, 50; for tints, 89, and for shades, 101.

Among saturated colors, the order of increasing pleasantness, together with the average affective value assigned to each color by our observers, is as follows: green yellow, 2.1; orange and yellow green, 2.6; red violet and green, 3; yellow, 3.3; yellow orange and blue green, 3.4; red orange, 3.6; violet red, 3.7; violet blue and blue, 3.8; orange yellow and blue violet, 4; violet, 4.4; orange red, 4.5; green blue, 5.3; red, 5.6. *Pure red is the pleasantest saturated color, and green blue comes next. There is a tendency to dislike yellows and yellow greens.*

Among tints, the order of increasing pleasantness is the following: violet red, 3.4; green yellow, 3.8; orange, 4.3; yellow and orange yellow, 4.4; yellow orange, 4.5; blue green, red orange, and red, 4.6; green blue and orange red, 4.7; green, 4.3; yellow green, 5; violet blue, 5.1; blue violet, 5.5; red violet and violet, 5.9; blue, 6. *Blue is the pleasantest light tint, and indeed the pleasantest color in the whole series.*

Among shades, we have the following order of increasing pleasantness; yellow, 2.3; orange yellow, 2.7; blue green, 3.7; red violet, green yellow, yellow orange, and orange, 3.8; violet red, 3.9; red orange and orange red, 4.3; violet, 4.4; blue violet, green blue, and green, 4.5; red and violet blue, 4.8; blue, 5; yellow green, 5.3. *Yellow green is the pleasantest dark shade and blue comes next.*

It might seem that a study of the mean variations of these averages

would be of interest, as indicating the amount of unanimity in the tastes of our observers. But further thought reveals the fact that the mean variations are necessarily involved with the degree of pleasantness or unpleasantness indicated by the averages, and can have no independent significance. The smallest mean variations must belong to the highest and lowest averages, the largest mean variations to the averages of medium amount. For evidently if the average affective value of a color is four, the mean variation of that average may rise as high as three, since jndgments from one to seven are possible: but if the average affective value of a color is six or two, the mean variation can hardly rise above one and a fraction, since there can be no judgments above seven or under one.

THE DISCRIMINATION OF ARTICULATE SOUNDS BY RACCOONS.

By W. T. SHEPHERD, Ph. D.

The present paper in some respects may be considered as a supplementary report to one on the same subject made by Professor L. W. Cole, and published by him about three years ago.[1] In the work reported by Professor Cole, in which I assisted, four raccoons were used and in this later work, now to be presented, the same animals were employed. The results which are given here have not previously been published, and only in a minor degree can they be considered merely supplementary to the work of Cole. The experiments to be reported are concerned with the Discrimination of Articulate Sounds by Raccoons.

It is commonly believed, and with some degree of reason, that the higher mammals can be taught to respond to their names, or to express it more accurately, to discriminate articulate sounds and to make appropriate motor responses thereto. It is well known that cats, dogs, horses and other domesticated animals learn to respond to their given names; but it is not known, from well conducted experiments, whether there is in these cases a discrimination of quality, of loudness, or of time of the sound. The results that have been obtained with animals under experimental conditions have been few, and in some cases the differentiation of tone, and intensity has not been made. Thorndike, it will be remembered, found that cats were apparently able to discriminate sounds made by him, though not with a great degree of delicacy.[2] The sounds that Thorndike used were quite complex in character, such as, "I must feed those cats" and "My name is Thorndike." In his work on the functions of the temporal lobes Kalisher reported[3] having been able to get dogs to discriminate sounds made by an harmonium, but he was more interested in producing the association for the purpose of determining (after extirpation of different parts of the

[1]Concerning the Intelligence of Raccoons, Jour. Comp. Neur. And Psych. Vol. 17, p. 211.

[2]Animal Intelligence, 1898.

[3]Eine neue Hörprüfungsmethode bei Hunden, Sitz. d. Kgl. Ak. d. Wiss., X, 1907. p. 204 ff.

cerebral cortex) the cortical centres for sound perception than ability in his animals to discriminate sounds.

At the time the experiments were begun the raccoons were about six months old, and they had been trained for two months on various motor acts, reported in Cole's paper. In the early training period we had spoken to the animals, using different names, but the naming and calling was not done regularly and systematically. During the course of these preliminary experiments some of the animals had given indications of associating the sounds with reactions, and one in particular reacted often. Since no record of these experiments was made we cannot say how often the stimuli were given, and how well or poorly each animal reacted. For a period of two months following these trials no experiments on sound discrimination were made. Then the present work was begun.

For these tests each raccoon was placed in a separate cage which had a wire netting front. The four cages were arranged in different parts of the room and I sat at a distance of from four to eight feet from the cages. The names of the raccoons were called in irregular order, and I noted whether each responded only to the sound of his own name or to all the names. Each animal was fed when he responded to his own name (and was not fed when the other names were called). The animals were named, Jack, Jim, Tom, and Dolly. During these experiments all were kept very hungry.

1st day: In 168 experiments (42 trials for each animal) in which the reaction of turning and looking at me was taken as response, Jack reacted correctly 6 times, 3 doubtfully correct; Jim, 11 correct, 3 doubtful; Tom, 9 correct, 5, doubtful; Dolly, 1 correct, 2 doubtful. All the animals responded to the first call, but it is likely that was only an attention reaction; *i. e.*, a movement following a stimulus given by one familiar to the animals.

2nd day: After the preliminary trials of the first day I no longer fed the animals for this simple reaction. Responses were only noted correct when they climbed up the side of the cage, in addition to looking at me. Each raccoon was fed after his name was called, whether or not he gave the proper reaction. In 188 experiments (47 for each animal) Jack reacted correctly 21 times; Jim, 9; Tom, only 2 doubtful; Dolly, 1 correct with 4 doubtful. The results of these two days' experiments indicated that Jack and Jim could easily learn to respond to their names.

3rd day: Throughout the remainder of the experiments each animal was tested separately and the other three were kept out of his sight. I called the name of the animal, waited

10 seconds, if need be, for response, and then, whether or not a response was obtained, the animal was fed. Alternately with the name, the words "no feed" were called, and at these times the animal was not fed. In each case, as noted above, the correct reaction was considered to be obtained only when the raccoon looked at me and climbed up the side of the cage. In 50 trials on each kind of auditory stimulus Jack correctly reacted to his name 39 times and to "no feed" 22; in 30 similar trials Jim correctly reacted to his name 21 times and to "no feed" 15; Tom in 30 trials correctly reacted to his name 16 times, to "no feed" 10, with 13 doubtful in all; Dolly in 30 trials correctly responded to her name 15, to "no feed" 5, with 1 doubtful.

The experiments were continued in this way for 18 days, at the end of which time all the animals appeared to know their names perfectly. Thirteen days after the beginning of the experiments Jack correctly reacted to his name every time (25 trials), and incorrectly to the "no feed" signal only 3 times (25 trials). About the same percentages of correct and incorrect responses were obtained for Jack during the 8 succeeding days of the experiment. It appeared to me that Jack's few errors from this point might be accounted for by his eagerness for food.

After the names appeared to be well learned, as further test of auditory discrimination, I called other names, in addition to the individual's name, such as "box," "floor," after each name: *i. e.*, I called Jack, "box," "floor" in succession, and not alternately. No substantial difference in the percentage of proper responses was noted. It seems evident, therefore, that the animals had formed the habit of responding only when the appropriate sound was heard, and of not responding to other sounds. To further test the animals, I called the names and sounds in varying tones of voice, the lowest to the highest possible to me, and also had other persons call the words and names. With all the animals the responses were strikingly characteristic of discrimination.

May we, therefore, conclude that raccoons discriminate names or articulate sounds? The answer to this question will depend to a large extent upon the acceptance of the later experiments as conclusive. A serious objection to such a conclusion may be urged by some. It may well be said that, in the major part of the experiments, where the name and "no feed" were called alternately, the raccoons had learned to react alternately and that they reacted only to the rhythm of the stimuli. On the other hand, it must be remembered that following those experiments of alternate calls, there was a series in which the names were not called in any regular

order, and there was the same percentage of correct responses. Moreover, the addition of extra sounds to the names did not alter the proportional number of responses. Both of these later tests permit us to conclude, therefore, that the discrimination did take place.

It is of some interest to note that, Jack, which judging from the results of the earlier tests and from others to be reported in a later paper, was the most intelligent animal of the four, learned to associate the name with the proper response in 270[1] trials, Tom took 375 trials, Jim 425, while 500 trials were required for Dolly. This individual difference in animals experimented upon has been a noticeable feature in other experimenters' work, but to the mind of the writer not sufficient attention has been paid to it, and therefore animal psychologists have been content to work with a small number of animals (four, two, or even one) and to draw from their results too broad conclusions.

[1]That is to say I called Jack's name 270 times and the other words "no feed," etc., in addition.

BOOK REVIEWS

Die Sprachstämme des Erdkreises. Von PROF. DR. FRANZ NIKOLAUS FINCK in Berlin, Druck und Verlag von B. G. Teubner in Leipzig, 1909. p. viii, 143. Aus Nätur und Geisteswelt. Sammlung wissenschaftlich-gemeinverständlicher Darstellungen. 267. Bändchen.

Die Haupttypen des Sprachbaus. Von DR. FRANZ NIKOLAUS FINCK, Professor an der Universität Berlin, Druck und Verlag von B. G. Teubner in Leipzig, 1910. pp. vi, 136. *Ibid.*, 268. Bändchen.

These two latest additions to this excellent series of German handbooks on all manner of topics from superstition to forestry, and from the theatre to electro-chemistry, cannot fail to be of value to all interested in the comparative study of languages, although it is quite evident that a number of the problems raised of late years by the special investigations of the speech-forms of the American aborigines have not come to the author's attention. The first volume, "The Linguistic Stocks of the Globe," is a decided improvement upon the list in the second edition (1879) of Friedrich Müller's "Allgemeine Ethnographie," as may easily be proved by a glance at the indexes of the two books, and Müller's list has long remained the most complete and accessible to the German public. But the investigations of the last twenty-five years have put it altogether out of date, both as to accuracy and as to completeness. Dr. Finck classifies the languages of mankind under four races: Caucasian, American, Mongolian, Ethiopian (African and Oceanic Negroes). Under the Caucasian he lists the Indo-Germanic, the Hamito-Semitic, the languages of the peoples of the Caucasus (Caucasian in the minor sense), the Dravidian tongues of India and the Basque and Etruscan, besides certain other long extinct forms of speech belonging to Asia Minor, etc., such as Elamite, Chaldic, Hittite, Lycian, etc. There is too much mixture of race and speech in this classification. While, doubtless all the peoples of the Caucasus belong to the Caucasian or "white" race, ethnologists will hardly follow the author in separating the Dravidians entirely from the Australian aborigines and making them full-fledged Caucasians, against which view there are also arguments of a linguistic character. As members of the Mongolian race, the so-called Austro-Asiatic tongues (Kolarian, Mon-Khmer, Khasi, Nicobar, Semang, Senoi), Austronesian (Indonesian, Melanesian, Polynesian,—Malayo-Polynesian), Indo-Chinese (Tibeto-Burmese, Siamo-Chinese), Ural-Altaic (Samoyed, Finnic-Ugric, Turkic, Mongolic, Tungusic, Japanese, Korean, etc.), Arctic or Hyperborean (Yenesseian, Jukaghir, Chukchee-Kamtchatkan, Ainu, Aleuto-Eskimo), a classification impossible to justify in the light of the most recent investigations. The studies resulting from the Jesup Northwest Pacific Expedition, under the direction of Dr. Franz Boas, have rendered it extremely probable that the languages of the so-called Paleo-Asiatic peoples of Northeastern Asia (Koriak, Kamtchatkan, Chukchee, Yukaghir, etc.) will be finally classed with the American Indian tongues. The Ainu must still be recognized as isolated among the Asiatic peoples, but there is more reason for affiliating them with the Caucasian race, than there is for so doing with the Dravidian. The inclusion of the Kolarian, the Mon-Khmer and the Melanesian in one group is open to fatal objections, while the Semang and Sakai of Malacca are hardly to be looked upon as Mongolian, nor can one be sure in placing there the Nicobarese, etc. And there is no good reason for cutting off the Eskimo from the rest of the American aborigines

as Dr. Finck does. The Sumerians of ancient Babylonia, about whose ethnological relations there is still not a little doubt, are here listed as Mongolian. The languages of the American race receive the most lengthy treatment (pp. 68-105) of any of the groups, the author following the regional method of cataloguing the chief stocks (North Pacific, North Atlantic, Central, Amazonian, Pampas, Andine or South Pacific), with indications of many of the smaller isolated tongues within these large areas. For North America Powell seems to have been followed generally, with some reference to later authorities (to judge from certain portions of the text). The modifications in the Powellian list, made necessary as the result of the more recent investigations of American philologists (and not included in Dr. Finck's summary) will be found in the articles on "Linguistic Stocks" in the "Hand book of American Indians North of Mexico" (Washington, Vol. I, 1907) and in the article on "North American Indians" in the forthcoming new edition of the "Encyclopedia Britannica." Dr. Finck, however, notes some of these latter results, *e. g.*, the inclusion of the Adaizan with the Caddoan, the Piman with Uto-Aztecan, etc. The latest researches of Lehmann in the Central American region seem likely to lead to some changes in the arrangement of the linguistic stocks between Mexico and Panama. To the linguistic stocks of South America the writer of this review has devoted considerable attention, and a monograph on that subject is preparing for publication. Dr. Finck's list of South American stocks, while, of course, not exhaustive, takes in such comparatively recent items as the recognition as independent forms of speech of the Trumaian, Bororoan, Makuan, Miranhan, Guatoan, etc. The Onan of Tierra del Fuego is, without justification, classed as a dialect of Tsonekan (Patagonian); the evidence in hand still makes it necessary to list it as an independent stock. The independent character of Atacamenan, is however, recognized. On the whole, the list of South American stocks is fairly accurate so far as it goes, and free from any important errors. The languages of the Ethiopan race include those of the Negroes of Africa (Paleo-African, *i. e.*, Bushman, Hottentot; Neo-African: Bantu, West-Sudan, Central-Sudan, Nilotic, etc.) and the Oceanic Negroes (Australian and Tasmanian, Papuan, Andamanese). The most recent studies of the linguistic relations of the peoples of New Guinea and adjacent islands will necessitate some modifications of the lists in this region. In the introduction the author touches upon the question of the human "Ursprache," but wisely remarks in conclusion (p. 7) "discussion of the temporal sequence of the various linguistic stocks is impossible, and even the degree of their antiquity cannot be settled, since we are altogether ignorant of the supposed unitary primitive tongue of all mankind." In the second volume on "the Chief Types of Language," Professor Finck selects and discusses, with considerable detail, the grammatical and morphological peculiarities and characteristics of types of human languages (Chinese, Greenland Eskimo, Subija,—a language of the Zambezi region in South Africa, Samoan, Arabian, Greek and Georgian of the Caucasus). These eight languages are treated as "typical representatives of eight groups, to which, in my opinion, can without any great violence, be assigned the languages of the whole earth (p. v.)." If one takes as criterion the idea-content of the word, these languages, "with the gradual strengthening of the fragmentary character and the increasing morselizing of the idea masses present before the beginning of speaking," the languages in question can be arranged in the following order: Eskimo, Turkish, Georgic, Arabic, Chinese, Greek, Samoan, Subija. From another point of view, that of the organization of the elements of the sentence, etc., quite another order is necessary, and Dr. Finck distinguishes them thus: Root-isolating (Chinese), stem-isolating (Samoan), root-inflecting (Arabic), stem-inflecting (Greek), group-inflecting (Georgic), subordinating (Turkish), incorporating (Eskimo), and ordinating (Subija). Still other arrange-

ments, from other points of view are of course possible. The difficulties of such a type-theory as that set forth by Professor Finck are apparent from consideration of the languages of the Old World, but they multiply and intensify themselves when the linguistic stocks of the New World are carefully examined. The "Handbook of American Indian Languages North of Mexico," soon to be published by the Bureau of American Ethnology, under the competent editorship of Dr. Franz Boas, will, for the first time, present accurate and convincing evidence upon many points connected with the speech-types of the aborigines of the United States and Canada. Suffice it to say, for the present, that the Eskimo of Greenland can hardly serve as representative for all the Indian tongues of that region, much less for all those others of Mexico, Central and South America as well. Under any system of type-listing there must be many more than one type among the many scores of linguistic stocks living and dead in primitive America. A valuable part of this volume, and one especially interesting to psychologists, will be found in the analyses of texts accompanying the discussion of each linguistic type. The first volume has an exhaustive index, and the presence of one of some sort would not have injured the second.

ALEXANDER F. CHAMBERLAIN.

Studies in Spiritism, by AMY E. TANNER, Ph. D., with an introduction by G. Stanley Hall, Ph. D., LL. D. New York, Appleton, 1910. 408 pp.

This volume records the findings and verdict of a patient investigation sustained by a scientific conscience and enthusiasm. It represents constructively a logical interpretation of a group of phenomena whose psychological importance, though distinctive, seems modest when compared with the far-reaching conclusions attached to them by the popular verdict in favor of the supernatural. The convincing emphasis of the book is its indication that the "psychic research" platform is not only logically inadequate but psychologically perverse.

While the psychology of Paladino has been relegated to the limbo of fraud and credulity, the psychology of Mrs. Piper remains; for there seems no doubt that her sittings, whatever their more subtle or questionable implications, represent distinct if evasive phases of a secondary personality. Therein lies their interest, and not in their supposed evidential revelations. For exhibiting clearly and with illustrative detail the evidence that mediumistic trance is psychologically a form of lightly or deeply held secondary personality, Dr. Hall and Miss Tanner deserve credit and gratitude. Though the position,—and it would be surprising to find it otherwise,—has been favored and presented by other psychologists, it has not as yet received so clear a statement, so full a demonstration, nor indeed so original an exposition.

It is difficult soberly to take space to recount the endless records by which the advocates of Mrs. Piper's supernormal powers support their claim. In the "test" messages some objective control is exercised; and complex coincidences,—difficult, if not impossible to appraise,—enter to make or mar the case. Miss Tanner pursues the only way open to the dauntless critic: she analyzes the incidents, lays bare the constant sources of error, the looseness of interpretation, the ready play of chance, and with the structure thus stripped of prejudicial veneer she displays its card-board architecture. For the apologetics that have been used to make coincidence startling, and to read mysteries into commonplace trifles are no less amazing when one considers the intellectual standing of the protagonists. The psychological transgression is no less astounding; the credence given to long-range memories, the scant appreciation of the efficiency of suggestion, the neglect of control experiments, as well as the amateurish attitude towards such every-day foibles as "fishing," fooling, and lying, arouse pity or irritation, according to temperament.

Yet the great bulk of the "evidence" is of yet looser construction, and depends upon the presumption that Mrs. Piper's inspired hand can write messages revealing details that the terrestrial Mrs. Piper could not normally have acquired. Once more the truth is simple. It is abundantly clear that Mrs. Piper's auditory centres are keenly alert when her eyes are closed in trance; her surviving consciousness listens acutely, "fishes" adroitly, and her reeling in to suit the sporting impulses of the victim is nothing less than professional. As in dreams, the subject unwittingly contributes the data for the solution, and then marvels at the revelation when it appears. As for the spiritual hypothesis, why not be frank and say with Dr. Hall: "It is an utter psychological impossibility to treat this subject seriously."

Mrs. Piper pretends to be controlled by the actual disembodied Richard Hodgson. Not only, however, does the latter fail to prove his identity, but he is suggestible, ignorant, inconsequential and Piperian. With alacrity he summoned from the spirit-world wholly fictitious personages, as well as the shades of the known departed; he fell into the most simple logical traps, and through Mrs. Piper's organism exhibited pique and ill-temper at being exposed,—quite out of the rôle of the shrewd exposer of mystery that Hodgson was. A few whiffs of this atmosphere sends one back gasping to the fresh air. "Spiritism is the ruck and muck of modern culture, the common enemy of true science and of true religion; and to drain its dismal and miasmatic marshes is the great work of modern culture. . . . . We have largely evicted superstition from the physical universe, which used to be the dumping-ground of the miraculous. Superstition to-day has its strongest hold in the dark *terrae incognitae* of the unconscious soul of man towards which researchers to-day are just as superstitious as savages are towards lightning, eclipses, comets and earthquakes."

Taking seriously the proposition that telepathy is supported by premonitions and experiments, that trance messages really foretell the future and reveal the past, that the controls of mediums bring back credentials which are adequate for the identification of the recently departed, psychology accepts the challenge and undertakes to show that a pervasive bias and a defective insight have shaped the data to distorted or imaginary significance. The evidence for this position cannot be summarized. Those who are interested in acquiring a hold upon it have now available Miss Tanner's presentation. On the other hand, recognizing that subconscious abnormalities arise spontaneously, and grow by what they feed upon, psychology finds in the encouragement given to the medium's sittings, in the serious systematic acceptance of the spiritistic hypothesis, and in the devout personal reactions of sitters, the hot-house atmosphere and the coddling ministration that such parasitic growths absorb. The conspicuous suggestibility of such temperaments makes them assume the forms that excite interest and claim attention. They are allied to a recognized group of hysterical manifestations in the nearly normal, which in turn grow to troublesome intrusion or withdraw to manageable control according to the wisdom and insight with which they are met. The modern attitude towards such phenomena is a therapeutic one. The mediumistic or secondary personality is to be appeased, persuaded, suppressed, and the patient's resources united and made to see and to live life steadily and whole. Such a consummation can never be, if the abnormality is displayed, cherished, and embraced as a means of livelihood.

Dr. Hall is confident that "the mysteries of our psychic being are bound ere long to be cleared up. Every one of these ghostly phenomena will be brought under the domain of law. The present recrudescence here of ancient faiths in the supernatural is very interesting as a psychic atavism, as the last flashing up of a group of old psychoses soon to become extinct.

When genetic psychology has done its work, all these psychic researches will take their places among the solemn absurdities in the history of thought; and the instincts which prompted them will be recognized as only psychic rudimentary organs that ought to be and will be left to atrophy."

University of Wisconsin. JOSEPH JASTROW.

The Metaphysics of a Naturalist; Philosophical and Psychological Fragments. By the late C. L. HERRICK. Bulletin of the Scientific Laboratories of Denison University, Vol. XV. Granville, Ohio, 1910. 99 pp.

This book aims to supplement and, to some extent, to unify such of the distinctive philosophical teachings of Professor Herrick as have already been published, by adding to them and correlating with them material brought together from papers and manuscripts hitherto unpublished. The first chapter is entitled "The Summation-Irradiation Theory of Pleasure-Pain." It gives an analysis of feeling and of emotion, and explains them in terms of physiological tensions and adjustments, basing the arguments on bodily structure and function and upon introspection. There is also included a table of the other classes of mental processes, with their physiological parallels. At the end of the book are four short, less technical and less distinctive, chapters on the freedom of the will, the problem of evil, immortality, and ethical conclusions. The book is chiefly concerned to present the metaphysical theory of dynamic monism, and to explain, in terms of this theory, the concept of consciousness, the relation of mind and body, individuality, matter, life, etc. Some of the fundamental conclusions are: Existence (being) and energy are identical; Energy is pure spontaniety; Unimpeded infinite energy would seem to us indistinguishable from non-existence; Force arises from the interference of energy, and implies resistance; The complexity of resistance measures the quality of the force, the degree of resistance measures the quantity of the force; Matter is a subjective interpretation of forces in a state of relative equilibrium; Consciousness is the focussing of diverse forces upon the complicated neural equilibrium; Conscious states are epiphenomena, due to the constant becoming between energy and force. The writer makes frequent reference to the theories and results of the natural sciences, especially those of physics, physiology, and mathematics, and he takes over into his metaphysics, almost directly, such scientific concepts as inertia, resistance, motion, energy, vortices, vectors, etc. According to the editors, the book is intended as a contribution to work on the methodology of the sciences, of the sort done by Tyndall, Huxley, Kelvin, Helmholtz, Mach and Ostwald. W. S. FOSTER.

Les rêves et leur interprétation. Par PAUL MEUNIER et RENÉ MASSELON. (Collection Psychologie Exéprimentale et de Métapsychie). Bloud et Cie, Paris, 1910. 211 p.

This is an essay in morbid psychology, both of the authors being psychiatrists. The first chapter, entitled the psychological mechanism of dreams, gives a partial résumé of the scientific literature of dreams, chiefly of French work, supplemented by contributions from the authors' own observations. The second chapter discusses the diagnostic value of dreams. While there is much difficulty in distinguishing the truly prodromic or symptomatic dream from accidental dreams without pathological significance, the authors, nevertheless, conclude that dreams are in some cases of considerable value in diagnosis and the following chapters are devoted to a discussion of the distinguishing characteristics of dreams in infections and intoxications, neuroses and insanities, which have diagnostic significance, *e. g.*, the color, red, persistently appearing in dreams is a frequent phenomenon in premenstrual periods, cardiac affections, premeningeal attacks, inflammatory infections of the eye and the aura of epileptic attacks. Terrifying hallucinations and zoöscopy are characteristic not only of

alcoholism but are liable to occur in all toxic affections. Stereoptyped dreams occur in epilepsy and hysteria.

In psychoses, the dream may reveal an obsession or an impulsive tendency before it has been manifested in the waking state. Finally, in mental pathology the persistence of dreams is a sign of the manifest activity of morbid processes and in convalescence, the type of dreams may be of great importance for determining the state of the patient.

The book is disappointing in that it takes no account of Freud's Traumdeutung or of De Sanctis' later work, by far the two most important contributions to the psychology of dreams and without consideration of which any discussion of the subject must be inadequate.

THEODATE L. SMITH.

L' année psychologique, publiée par ALFRED BINET. Paris, Masson, 1910. 500 p. Seizième année.

Besides the usual literature, the author himself has monographs upon the physical signs of intelligence, on Rembrandt in relation to the new style of art criticism, the mental states of the insane; while with Simon he gives us an extensive study of hysteria and on insanity with consciousness of it, of the maniacal depressive type, the systematized form, and dementia, retardation, formulating a new classification. Finally comes a brief article on judicial diagnostics, while the bibliography occupies pages 382 to 500.

A beginner's history of philosophy, by HERBERT ERNEST CUSHMAN. v. 1. Ancient and mediæval philosophy. Boston, Houghton, Mifflin (1910). 406 p.

This work is dedicated to Professor Palmer and is intended as a text-book for sketch-courses in the history of philosophy. It is for the student rather than the teacher; and is written on the background of geography and literary and political history and uses many tables. The present volume begins with the early Greeks and ends with Ockham.

Psychologie des Kindes, von ROBERT GAUPP. 2d enl. ed. Leipzig, Teubner, 1910. 163 p.

This work is divided into three parts. The first treats the psychology of the little child, beginning with a brief historical sketch of child psychology, a discussion of its methods, literature, the development of the first year of attention, speech, Gemüt, will, thought, lies, impulses, sense play, etc. The second part is on the psychology of the school child, beginning with entrance, and discussing memory, attention, power of achievement and control, fatigue, power of judgment, writing, the child and its relations to art. The third part treats of children who are psychically abnormal.

Trick methods of Eusapia Palladino, by STANLEY LE FEVRE KREBS. Reprinted from The Reformed Church Review, Vol. XIV, July, 1910. Phila., 1910. p. 337-383.

This author concludes that Palladino uses no confederate, that there are no traps or sliding panels, that all her phenomena are produced in an area within the stretch of her arm or leg, certainly if lengthened a little by the use of a flower stand as a reacher and a shoe-ledge as a fulcrum for levitation. The author does not believe that she has any extraordinary or telekinetic power. If she had she ought to be "lifted out of the realm of showdom;" nor does he believe that the hypothesis of survival after death will be proven by any phenomena like hers. It is all a deception of sight and touch, "the psychological atmosphere being helped along by intentional suggestions." She always dresses in black and her cabinet is painted black inside; he would have her dress in white. He thinks, too, that if she were placed at the broadside of a table and had only one per-

son control both her hands and both her feet, "John," her control, would be put out of business. He would tie her ankles and wrists with a slack of only four or five inches, but none of these she will allow.

Über Ermüdungsstoffe, von WOLFGANG WEICHARDT. Stuttgart, Enke, 1910. 66 p.

This is an interesting and compendious account of the large subject treated. Symptoms of extreme general fatigue are first described; then the fatigue of special parts and organs, investigations on immunity and fatigue stuffs, the attempts to apply chemical and physical means to muscle extraction and to albumen, how kenotoxine can be influenced, active immunization, anti-somatic influences, how pathological processes can be influenced by antikenotoxine.

An introduction to the study of hypnotism, experimental and therapeutic, by H. E. WINGFIELD. London, Baillière, Tindall & Cox, 1910. 175 p.

This book is an attempt to supply a simple answer to the question What is hypnotism? and makes no effort to range itself with the many larger works on the subject but intends rather to serve as an introduction to these. The matter is treated mainly from the experimental point of view and the author does not attempt to include anything that those already familiar with the subject did not already know. Its chapters are on the subconscious, the methods of inducing hypnosis, its phenomena and stages, other hysterical phenomena, treatment by suggestion, and the case against hypnotism.

The concept standard, a historical survey of what men have conceived as constituting or determining life values; criticism and interpretation of the different theories. By ANNE M. NICHOLSON. Teachers College Columbia University Contributions to Education, No. 29. New York, Teachers College, 1910. 138 p.

The chapters are: the fundamental categories and principles, the standard in primitive societies and the genetic point of view, review of the conception of the standard and its method of functioning from the first historic to present time, standard as conceived in epochs Judæan, Medieval, Renaissance, Protestantism, Cartesian, the English School, German idealism, the materialistic concept of this standard, its function in national crises.

A text-book of psychology, by EDWARD BRADFORD TITCHENER. New York, Macmillan Company, 1910. 565 p.

This work was written to take the place of the author's Outlines of Psychology in 1896 which has passed beyond the possibility of revision. Still it follows the general lines laid down in the Outline, although with less space devoted to nervous physiology. The work in its present form will be gratefully received by teachers and it is unquestionably the best in its own specific, if restricted, field.

The qualities of men, by JOSEPH JASTROW. Boston, Houghton, Mifflin Co., 1910. 183 p.

A study of the qualities of men in which a physiological interest in humanity is prominent may properly be expected to undertake the analysis of the fundamental factors in human nature, their transformation, values in growth, education and vocation. This is the basal problem in the psychology of human traits. For the elucidation of this theme, the author is preparing a work entitled Character and Temperament, but in the preparation for this work he found the more general bearing of the problems of human quality of growing importance and felt the need of a more general form and statement and a wider appeal. Hence this book, the chapters of which are the sensibilities, the ideals of appreciation, the support of the

sensibilities, the analysis of quality, quality in circumstance, compatibilities of quality, the poietic qualities, the social encouragement of quality, its upper ranges, its interactions with environment, its relation to careers and the realm of practice.

Die Phantasie nach ihrem Wesen und ihrer Bedeutung für das Geistesleben, von A. SCHÖPPA. Leipzig, Dürr, 1909. 144 p.

The chief topics here are the essence of phantasy, its relations to psychic life, with a good section on the playing, speaking, narrating, drawing, child, on the instruction of the fancy in childhood, phantasy in everyday life, in poetry, rhyme, rhythm, saga, legend, idyll, romance, fable, drama, phantasy in music, in the plastic arts, in science, and finally in religion. The author's psychology is mainly under the influence of Wundt, Lipps and Mach.

Die Sinnesorgane der Pflanzen, von G. HABERLANDT. Sonderabdruck aus der vierten Auflage der physiologischen Pflanzenanatomie, S. 520-573. Leipzig, Engelmann, 1909.

This reprint is an excellent little epitome of its subject, discussing the relations of the organ to the stimulus, with many cuts of sensory hairs, bristles, statoliths, stalks, leaves, with experimental observations on the connection of statoliths and geopterception. The writer discusses the light sense in leaves, the nature of their papillary epidermis and of optical spots, etc.

The metabolism and energy transformations of healthy man during rest, by FRANCIS G. BENEDICT and THORNE M. CARPENTER. Washington, Carnegie Institution, 1910. 255 p.

The first part of this book is introductory, telling what has been done before and elsewhere. The second is statistics of experiments; and the third and most elaborate is the discussion of results, which are not, unfortunately for the reader, summarized.

Der Traum und seine Deutung, nebst erklärten Traumbeispielen, von E. J. G. STUMPF. Leipzig, Mutze, 1899. 188 p.

This book, although not new, may have a certain added interest just now on account of the prominence which the problem of dream psychology has assumed in this country owing to the recent influence of Freud. Stumpf treats in the successive chapters, day and night in their reciprocal relations, and the nature and essence of dreams. These are the two sections of the book. If the author had designed to block every one's endeavor to get at the root idea of his treatment without reading every sentence in the book, he could hardly have succeeded better, for there is no index or titles of any kind, apparently no summaries or epitomes, nothing italicized; so that as it is the book stands like a castle, attractive outside and doubtless full of good things within, but open under no conditions to casual visitors but only those who desire to reside in it.

A first book in psychology, by MARY WHITON CALKINS. New York, Macmillan, 1910. 419 p.

This book is written under a growing conviction that psychology is best treated as a study of conscious selves in relation to other selves and to outer objects. This book differs from an introduction to psychology, with which it is liable to be confounded, for here the approach is simpler and more direct. In the former book, psychology is treated both as a science of selves and of ideas and all is discussed from both points of view. Here the double treatment is abandoned. Here, too, the author has tried to embody the results of functional psychology, that is, taking an account of bodily reactions and environment which accompany thought, feeling and will. An appendix, too, treats of the physiology of the nervous system

and the senses and abnormalities. "This is, then, a new book, not the condensation of an old one, yet it does not teach a new form of psychology." The chief sections here are, methods and uses, perception and imagination, other sensory elements, their combinations and differentiations, effect, attention, productive imagination, memory, selective association, recognition, thought, conception, judgment, reason, emotion, will, faith and belief, the social and religious consciousness. The appendix includes pages 273 to 417.

Straight goods in philosophy, by PAUL KARISHKA. New York, Roger Brothers, 1910. 207 p.

This name, we take, it, is a pseudonym. The author, who has already written several other very stimulating but inadequately appreciated works, is evidently a thinker born and trained. He here gives up the more erudite subtleties of metaphysics and speaks to the plain man and tells him that philosophy simply means wisdom in work. It is really impossible to give an adequate conception of this work, which certainly shows a very wide repertoire of insights and interests on the author's part. It has nearly forty chapters. Some of them are loving everybody, the professional philosophy, healing the body by mind, posing, the things we hate, sympathy, the funeral of a living corpse, weeds, man and woman, thoughts that kill, food, why women are sly, old age, the law of opposites, privileged people, the essentials of a philosophic life. The book is certainly original, suggestive and stimulating.

Educational psychology, by EDWARD L. THORNDIKE. 2d ed., rev. & enl. Teachers College, Columbia University, N. Y., 1910. 248 p.

This book is a revision of a work which appeared in 1903. Its primary purpose is to provide students in advanced courses in educational psychology with the material which they would otherwise have to get at lectures at great time and cost. The author has admitted the influence of special training upon more general abilities. He treats the measurement of individual differences, the influence of sex, of remote ancestory or race, of immediate ancestry or family, of maturity and environment, the nature and amount of individual differences in single traits, the relation between the amounts of different traits in the same individual, the nature and amount of individual differences in combinations of traits, types of intellect and character, extreme individual differences, and exceptional children, with several appendixes.

The World a Spiritual System. An outline of metaphysics. By JAMES H. SNOWDEN. N. Y., Macmillan, 1910. 316 p.

The author is evidently in an apologetic state of mind, at least in his preface, quoting various definitions of metaphysics, such as "a blind man looking on a dark night for a black cat that isn't there." However he tells us that the difficulties and the confusion are more apparent than real. He discusses in successive chapters the nature of metaphysics, including its definition, method, assumptions, spirit, object and system. He then discusses the different points of view from which the world is regarded, viz.: from that of plain men, the scientist and the metaphysician; the subjectivity of space, with its theory and reasons, that of time, subjective reality, the soul's knowledge of itself, its fundamental character, general character; how we reach objective reality; its nature, including the world as phenomenon; as life, as thought, sensibility, will, the general character of the world and man as its key. Then follow the relations of the world and God as revealed as cause in its relations to man, and finally the applications of idealism as seen in the relations of mind and body, immortality, problem of evil, idealism in religion and life, with a brief suggestive course of reading and some account of the chief modern writers upon these subjects.

The use of the Theory of Correlation in Psychology. WILLIAM BROWN, Cambridge. Printed privately at the University Press, 1910. p. 83.

Some Experimental Results in the Correlation of Mental Abilities. WILLIAM BROWN. *The Journal of Psychology,* Vol. 3, 1910, 296-322.

An objective Study of Mathematical Intelligence. WILLIAM BROWN. Biometrica, Vol. 7, 1910, p. 352-367.

The use of the Theory of Correlation in Psychology. WILLIAM BROWN. Cambridge. Printed privately at the University Press, 1910. p. 83.

The paper, which is a doctor's thesis, consists of three parts, the first of which contains an exposition of the theory of correlation, the second the history of the use to which this theory has been put in psychology, and the third the description of a series of investigations undertaken by the author. The third part has appeared separately under the title "Some Experimental Results in the Correlation of Mental Abilities" in the British Journal of Psychology, 1910, Vol. 3, p. 296-322.

Starting from the notion of the regression curve and regression line the author develops formulæ for the coefficient of correlation, for the correlation ratio, for the probable errors and for multiple correlation and then proceeds to discuss some other methods of measuring correlation. The method of ranks and its critisicm by Pearson is discussed in some detail. Pearson's objections against this method are directed (1.) against the use of rank as a quantitative measure of character, and (2.) against the formulæ derived by Spearman, for which new ones are substituted. Rank must not be used as a quantitative measure of character, because this assumes that the unit of rank is the same throughout the scale, which is not the case since the unit of rank between mediocrities is practically zero, while it is very large between extreme individuals. This argument of Pearson gains additional interest in view of Cattell's classification of men of science according to ranks attributed to them by a number of more or less prominent men. If Pearson's argument should turn out to be correct, the supposition for averaging the ranks attributed to the same man in the different classifications are not given. Brown's short presentation of the theory of correlation is all the more significant, because it carries with it the authority of Pearson who read the proof. The notation used is the one customary in biometric treatises, which is perhaps not the most fortunate. The difficulties for the reader increase, if new signs are introduced without definition, as happens to be the case on p. 7.

Brown's discussion of the significance of the coefficient of correlation is very interesting. He insists on the fact that this quantity has a significance as a measure of the degree of community or identity of causation, if the regression curve is linear. He considers a general answer as to the significance of the coefficient of correlation impossible, but he tries to make it clear by an example known by the name of Weldon's experiment. A dozen dice are cast a number of times and the number of dice showing four or more spots is recorded. The results of the 1st, 3d, 5th, . . . throws obviously will be in no relation to those of the 2nd, 4th, 6th, . . . throws. We now make the results of the even throws dependent on those of the uneven. We stain six of the dice red and we make the even throws only with the six white ones, leaving the red ones on the table but counting indiscriminately the dice which show four or more spots. The results of the even throws will be correlated to those of the uneven throws and it is shown that in this case the proportion of factors common to the two series is given by the coefficient of correlation itself. This, however, is an exception since the extent of identity of causation as a rule is measured by an unknown function of the coefficient of correlation. Brown thinks that "a general lack of knowledge of the mathematical theory of correlation among psychologists" is responsible for the fact that in psychology, comparatively

little use is made of this theory, but it is the reviewer's opinion that this lack of interest may be attributed largely to the difficulty of explaining the real significance of the coefficient of correlation. Bruns, Lipps and Lachmann have supplied examples, where this quantity is void of significance and almost every one can construct examples where it is misleading. The specialists ought to give us a clear presentation of the theory of correlation and its applications to psychology and demonstrate at least the conditions under which the extent of community of causation is measured by an uneven function of the coefficient of correlation, because in this case one would be sure that a negative value of the coefficient of correlation does not indicate a positive correlation.

The historical part of the paper shows that the theory of correlation has been used in psychology chiefly for the study of the relation of different mental abilities to one another and to general intelligence. The first investigation showing any mathematical precision was undertaken by Clark Wissler, and was followed by one by Aikins and Thorndike; the correlations between mental abilities were generally low. Spearman, instead of working on large groups, took groups of small size, making up for this deficiency by subjecting his raw data to a mathematical treatment. He finds a hierarchy among the different school subjects and concludes that these different mental activities are saturated with one common fundamental function (or group of functions). This essential element in intelligence is supposed to coincide with the essential element in sensory functions. Spearman's results were tested by Thorndike, Lay and Dean, who concluded from their results that there exists a complex set of bonds between the formal side of thought and its content, and that there is nothing whatever in common to all mental functions or to any half of them. C. Burt confirmed Spearman's results in so far as he found a hierarchy in the subjects tested, but he believes that the central factor is voluntary attention. The author then mentions the paper of Pearson on the relationship of intelligence to physical and mental characters, the work of Miss Elderton, who evaluated the data collected by Heymans and Wiersma and those of Ivahhoff, the later work of Thorndike and of his pupils and his own Objective Study of Mathematical Intelligence (in Biometrica, Vol. 7, 1910, p. 352-363). He found that algebra and geometry show hardly any correlation, a result which coincides with the one obtained by Burris that the coefficients for the correlation between algebra and geometry is nearly as low as that between mathematics and a non mathematical subject.

The author's own experimental investigations were undertaken with a view of ascertaining the correlation of certain very simple mental activities to one another and to general intelligence as measured by school marks, teacher's judgments, etc. The experiments were made on tolerably large and fairly homogeneous groups of students, who were as far as possible identically situated in respect to previous practice, general training and intelligence. The tests comprised crossing out letters (two letters, four letters and all the letters) in a page of meaningless words, adding up digits in Kraepelin's Rechenhefte, bisecting and trisecting lines, measuring the Mueller-Lyer and the vertical-horizontal illusions, memorizing nonsense syllables and memorizing poerty, and combination (tested by the method of Ebbinghaus). The observation that a large proportion of the subjects show a negative vertical-horizontal illusion (*i. e.* underestimate the vertical line) is curious and of interest to the experimentalist also. The table of the coefficients of correlation shows no hierarchical arrangement except in one case where spurious correlation may be suspected. Extraneous sources of correlation, such as, *e. g.*, differences in the discipline, may influence the results in a constant direction and thus produce the hierarchical arrangement. The question as to the existence or non-existence of a central function is not answered definitely, but a number of results may be

taken as arguments against its existence. A definite answer can be given only on the basis of experiments on much larger groups, which will give results with smaller probable errors. Brown's results may be considered to bear out to some extent the views of Thorndike and to contradict those of Spearman. F. M. URBAN.

Der Begriff des Instinktes, einst und jetzt; eine Studie über die Geschichte und die Grundlagen der Tierpsychologie. HEINRICH ERNST ZIEGLER. Zweite, verbesserte und vermehrte Auflage. Jena, Gustav Fischer. 1910. VI+112.

This book sketches the historical development of the concept of instinct and discusses the modern significance of the term. The author points out that in early Greek thought no sharp distinction was made between the characteristics which were attributed to human and to animal consciousness. But in the system of Plato abstract thought was held to be the essential activity of mind; since this capacity cannot be ascribed to animals a sharp line of demarcation was now drawn, for the first time, between the human and the animal mind. And perhaps the most valuable contribution which the author offers to his readers is his elaboration of the thesis that ever since the time of Plato there have existed side by side, a tendency to magnify or even to humanize the animal mind, and a counter-tendency to relegate it to a low level on the scale of consciousness, if not to deny its existence. The doctrines of the Christian church were influenced by Greek idealism, and the Platonic conception of the animal mind was appropriated and emphasized by the theologians. But if animals are wholly lacking in intelligence how is one to explain the manifest appropriateness and efficiency of their behavior? The question was answered by an appeal to instinct,—a concept which had been introduced by the Stoics,—and instinct was conceived to be an institution of nature in virtue of which animals are enabled to react appropriately without themselves being able to foresee, or even to perceive, the appropriateness of their reactions. Instincts were held to be divine creations, and they were even cited as proofs of the wisdom of their creator. This view was defended by Aquinas, Descartes and others, and it came to be a dogma of theology,—and Ziegler cites Altum and Wasmann as its modern representatives. The position which the vitalists assumed was not essentially different. This dogma was opposed by Montaigne and by Gassendi; and subsequent contributions to the humanizing or anthropomorphic movement were made by Leibnitz, Condillac, La Mettrie, Brehm, Vogt, Büchner, and numerous others. A new era in the history of instinct begins with Darwin. Instinct is no longer regarded as the peculiar characteristic of animal endowment; numerous human instincts are shown to exist and to be of profound significance. Moreover the fact that instincts are appropriate and serviceable is now explained from natural causes. Ziegler discusses and rejects Lamarckianism,—among whose representatives he mentions Haeckel, Preyer, Hering, Wundt and Semon. His own view of instinct is based upon the Weismann conception, and has, as the author shows, much in common with the view of Lloyd Morgan. He enumerates a list of criteria which differentiate instinctive from intelligent behavior, but the list contains nothing which is essentially new. The difference between instinctive action and intelligent action is referred to the assumption that the former is due to inherited paths in the nervous system, while the latter is due to acquired paths.

In an (illustrated) appendix Ziegler discusses the brain anatomy of the bee and the ant, and points out that the three classes within the colony (queens, drones and workers; males, females and workers) which manifest typically different instincts, also possess typical differences of brain structure.

The book is written by a zoölogist, whose discussions frequently display a lack of critical insight into the problems of comparative psychology. But his historical sketch is a valuable contribution to the literature.

J. W. BAIRD.

The phenomenology of mind, by G. W. F. HEGEL. Edited, with an introduction and notes, by J. B. Baillie. London, Swan Sonnenschein, 1910. 2 v.

The translator well says that this has long been recognized as a unique product of Teutonic genius, "on the whole perhaps the most remarkable treatise in the history of modern philosophy." This is true both as to the style of thinking, its expression and the comprehensiveness of its theme. It is an attempt to give an exhaustive analysis of the life history of the human spirit, to reduce its complex and involved harmonies to their elemental leading motives, and to express these controllong ideas in an orderly and connected system. The courage that made this effort possible was due to the state of the intellectual atmosphere of the times, which was charged with grandiose ideas that were capable of stimulating and sustaining philosophical enthusiasm and exciting and intoxicating speculative ambition. The writer thinks that Hegel was inspired by Kant to sail these unknown speculative seas with only a fraction of his scientific knowledge and none of his philosophical prudence. Still there is an enormous wealth of presentative material behind this treatise which shines through it. The discussion is often foreshortened and the scheme of the work is out of proportion, some points being treated with great elaborateness and others very concisely. The last part of the work is especially unsatisfactory and it is no excuse that it was written hastily just before the battle of Jena in 1806.

The translator certainly had a difficult task before him and he merits the very hearty thanks of all students of philosophy who have for years looked, no matter how well they read German, to this work with mingled feelings of curiosity and awe.

Manual of mental and physical tests; a book of directions compiled with special reference to the experimental study of school children in the laboratory or classroom, by GUY MONTROSE WHIPPLE. Baltimore, Warwick & York, 1910. 534 p.

All psychologists will be grateful to the author for the compilation of this manual. The general groups of tests are anthropometric, those of phsyical, mental and sensory capacity, of attention and perception, of effort and description, of association, learning and memory, of suggestibility, of imagination and invention, of intellectual development, besides general tests.

A text-book of psychology, by EDWARD BRADFORD TITCHENER. N. Y., Macmillan, 1910. 565 p.

The present work has been written to take the place of the author's "Outlines of Psychology," which was stereotyped in 1896 and which, owing to the rapid progress of the science, has long since passed beyond the possibility of revision, despite the continued demand for the book. The author would have preferred to let it die a natural death, feeling that it would be impossible to recover the freshness and vigor of the first reading, but finally deciding to re-write, a first part, containing about half of this work, appeared in 1909, and we now have the remainder of it. The author and publisher intend to withdraw the "Outlines" from the market in the near future in the hope that this work, which follows the same general lines, will take its place.

Psyche: a concise and easily comprehensible treatise on the elements of psychiatry and psychology for students of medicine and law, by MAX TALMEY. N. Y., Medico-Legal Publishing Co., 1910. 282 p.

The writer divides the work into several parts, as follows: the psychology or physiology of the mental functions and their pathology, following under this latter section the rubrics of feelings, ideation, will and consciousness. Part three treats of the etiology of insanity; part four, its therapy; part five, special pathology.

The psychology and training of the horse, by COUNT EUGENIO MARTINENGO CESARESCO. London, Unwin, 1906. 334 p.

The chief sections of this book are headed, the mind of the horse, how the horse learns and how he must be taught, how he is taught obedience, fear and how to overcome it. The work is attractively written, bound and printed.

Ueber den Traum. Experimentel-psychologische Untersuchungen, von J. MOURLY VOLD. Herausgegeben von O. Klemm. Erster Band. Leipzig, Barth, 1910. 435 p.

This is a very interesting experimental study by a man who long practised upon himself and others binding limbs and otherwise restricting freedom of movement, noting the effect upon the dreams. The conclusion shows a very systematic relation and suggests the desirability of further experiments upon others.

Dogmatism and evolution. Studies in modern philosophy. By THEODORE DE LAGUNA and GRACE ANDRUS DE LAGUNA. N. Y., Macmillan, 1910. 259 p.

Dogmatism here denotes the body of logical assumptions which were generally made by the thinkers of all schools before the rise of theories of organic and social evolution. Its application is therefore very wide, including the empiricism of Berkeley and Hume as well as the rationalism of Descartes and Leibnitz. These studies do not claim systematic unity.

The science of poetry and the philosophy of language, by HUDSON MAXIM. N. Y., Funk & Wagnalls, 1910. 294.

After laying down some fundamental principles, the author proceeds to describe the evolution of analogical speech and discusses the question what poetry is and what not. Then follows an interesting chapter on profanity. Still others on the application of fundamental principles, the dynamics of human speech, philosophy of English verse, oratory, poetry, etc. The work is illustrated by a dozen or more quaint and mystic illustrations. The reviewer feels that it is difficult to do justice to this book.

The reasoning ability of children, by FREDERICK G. BONSER. N. Y., Columbia University, 1910. 133 p. (Columbia University Teachers College. Contributions to Education, No. 37.)

The author tested children chiefly of the middle and upper grades in problems of simple arithmetic, in supplying omitted words or completing sentences, in scoring out wrong words, in writing opposites, in selecting the best from ten reasons given for four different things, in selecting definitions, in giving in their own words the substance of poems. Returns were obtained from 757 children. The best test of general ability was that of opposites and the poorest of interpreting poems. The work is careful and painstaking in a high degree, but it tells us very little about children's power of reasoning and should have been designated a test of general ability among children.

Muscle-reading; a method of investigating involuntary movements and mental types, by JUNE E. DOWNEY. Reprinted from the Psychological Review, July, 1909. Vol. XVI, no. 4, pp. 257-301.

The central tendency of judgment, by H. L. HOLLINGWORTH. Reprinted from the journal of Philosophy, Psychology and Scientific methods, Aug. 18, 1910. Vol. VII, no. 17, pp. 461-469.

The perceptual basis for judgments of extent, by H. L. HOLLINGWORTH. Reprinted from the Journal of Philosophy, Psychology and Scientific Methods, Nov. 11, 1909. Vol. IV, no. 23, pp. 623-626.

The suggestive power of hypnotism, by L. FORBES WINSLOW. London, Rebman, Ltd., 1910. 90 p.

This work, which is dedicated to the officers and members of the Psychotherapeutic Society, regards its work as an old prophecy fulfilled, for Sir James Paget long ago said that some day some clever quack would disgrace physicians by curing by his will what they could not do by their remedies. After giving a general account of suggestion, duality of mind, the differences between subjective and objective, the author gives us the history of hypnotism, tells us of its schools and those of therapeutics, pays his respects to the pioneers of psychotherapy, discusses the rules governing its use, relations between crime and hypnotism, auto suggestion, hypnotism in the courts, power of suggestion in causing illness, the case of Elliotson, explains the secret of the pilgrimages to Lourdes, describes the effects of suggestion in dealing with inebriety and the drug habit, describes transference, fashion, which is purely suggestion, and concludes with a felicitation to the profession upon the fact that nearly all intelligent and progressive physicians have now accepted the main facts in this field.

Les lois morbides de l'association des idées, par M. PELLETIER. Paris, Rousset, 1904. 148 p.

After discussing the place of association of ideas in the psychic processes in general, the author characterizes them in the normal state and then discusses symptoms of mania and the incoherence of ideas that characterizes it and the causes of this incoherence. A final chapter treats of debility and how incomplete coherence affects them. The work is written essentially from the standpoint of a clinician.

Bulletin No. 2, Government Hospital for the Insane, Washington, D. C. Edited by WILLIAM A. WHITE. Washington, Gov't Printing Office, 1910. 135 p.

This work contains the following articles by Dr. S. I. Franz. The knee jerk in paresis, sensations following nerve division, touch sensations in different bodily segments, and Some considerations of the association word experiment. Dr. Achúcarro writes on some pathological findings in the neuroglia and in the ganglion cells of the cortex in senile conditions, on elongated and other cells in the Ammon's horn of the rabbit, plaque lesions in the ependyma of the lateral ventricles. The work ends with a final article by Dr. W. H. Hough on the comparative diagnostic value of the Noguchi butyric acid reaction and cytological examination of the cerebro-spinal fluid.

Die Frömmigkeit des Grafen Ludwig von Zinzendorf. Ein psychoanalytischer Beitrag zur Kenntnis der religiösen Sublimierungsprozesse und zur Erklärung des Pietismus, von OSKAR PFISTER. Leipzig, Deuticke, 1910. 122 p.

This work is dedicated to Professor Jung of Zurich and is an interesting new contribution to the rapidly growing number of Freudian interpretations of life.

Nature and man, by EDWIN RAY LANKESTER. The Romane's Lecture 1905. Oxford, Clarendon Press, 1905. 61 p.

Criticism and beauty; a lecture rewritten. Being the Romane's lecture for, 1909, by ARTHUR JAMES BALFOUR. Oxford, Clarendon Press, 1910. 48 p.

The judgment of difference with special reference to the doctrine of the threshold, in the case of lifted weights. By WARNER BROWN. University of California Publications in Psychology. Vol.I, No. I, pp. 1-71. Sept., 24, 1910. Berkeley, the University Press.

Biological mechanics. Book I, Psychology as a natural science. By M. CLINE. Oct., 1910. 75 p.

An experimental study of sleep. (From the physiological laboratory of the Harvard Medical School and from Sidis' laboratory), by BORIS SIDIS. Boston, Richard G. Badger, 1909. 106 p.

My life as a dissociated personality. by B. C. A. With an introduction by Morton Prince. Boston, Richard G. Badger, 1909. 47 p.

Die psychologene Sehnstörung in psychoanalytischer Auffassung, von SIGMUND FREUD. Sonderabdruck aus Aerztliche Standeszeitung. Jahrgang, 1910. No. 9, 7 p.

Über den Gegensinn der Urworte. Referat über die gleichnamige Broschüre von KARL ABEL, 1884, von SIGMUND FREUD. Sonderabdruck aus dem Jahrbuch für psychoanalytische und psychopathologische Forschungen. Band 11. pp.179-184.

Die zukünftigen Chancen der psychoanalytischen Therapie, von SIGMUND FREUD. (Vortrag; gehalten auf dem zweiten Privatkongress der Psychoanalytiker zu Nürnberg 1910.) 9 p.

The metaphysics of a naturalist; philosophical and psychological fragments, by C. L. HERRICK. Granville, O., 1910. 99 p.

Kleine Schriften, von W. WUNDT. Bd. 1. Leipzig, Engelmann, 1910. 640 p.

Der Begriff des Instinkts, einst und jetzt, von H. E. ZIEGLER, 2d. rev. and enl. Jena, Fischer, 1910. 112 p.

Leitfaden der experimentellen Psychopathologie, von ADALBERT GREGOR. Berlin, Karger, 1910. 222 p.

Evolution and Consciousness, by C. H. JUDD. Reprinted from the Psychological Review, March, 1910. Vol. XVII, pp. 77-97.

Der Begriff des Ideals. Empirisch-psychologische Untersuchung des Idealerlebnisses. (1. Lieferung), von A. SCHLESINGER. Sonderabdruck aus dem Archiv für die gesamte Psychologie, Bd. XVII, 1 and 2 Heft. Wilhelm Engelmann, Leipzig, 1910. pp. 231-309.

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Die Variabilität niederer Organismen. Eine deszendenztheoretische Studie, von HANS PRINGSHEIM. Berlin, Julius Springer, 1910. 216 p.

Die Evolution der Materie auf den Himmelskörpern. Eine theoretische Ableitung des periodischen Systems, von N. A. MOROSOEF. Autorisierte Uebersetzung von B. Pines & Dr. A. Orechoff. Dresden, Theodor Stein-Kopff, 1910. 41 p.

Vierteljahrsberichte des Wissenschaftlich-humanitären Komitees. April, 1910. Jahrgang 1, Heft 3. Fortsetzung der Monatsberichte und des Jahrbuchs für sexuellen Zwischenstufen mit Berücksichtigung der Homo-sexualität, von MAGNUS HIRSCHFELD. Leipzig.

An experimental Study of Dementia Præcox, by L. C. GATEWOOD. The Review Publishing Co., Baltimore. 70 p. (Reprint from The Psychological Review, November, 1909, Vol. XI, No. 2. Ohio State University Psychological Studies, Vol. I, No. 1.)

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Beitrag zur Lehre vom Querulantenwahn, von MAX LÖWY. J. A. Barth, Leipzig. (Sonder-Abdruck aus Zentralblatt für Nervenheilkunde und Psychiatrie, neue Folge, 21. Band, 1910. pp. 81-97.)

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Die Haupttypen des Sprachbaus, von FRANZ NICHOLAUS FINCK. B. G. Teubner, Leipzig, 1910. 156 p. (Aus Natur- und Geisteswelt. Sammlung wissenschaftlich-gemeinverständlichen Darstellungen. Bändchen 268.)

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